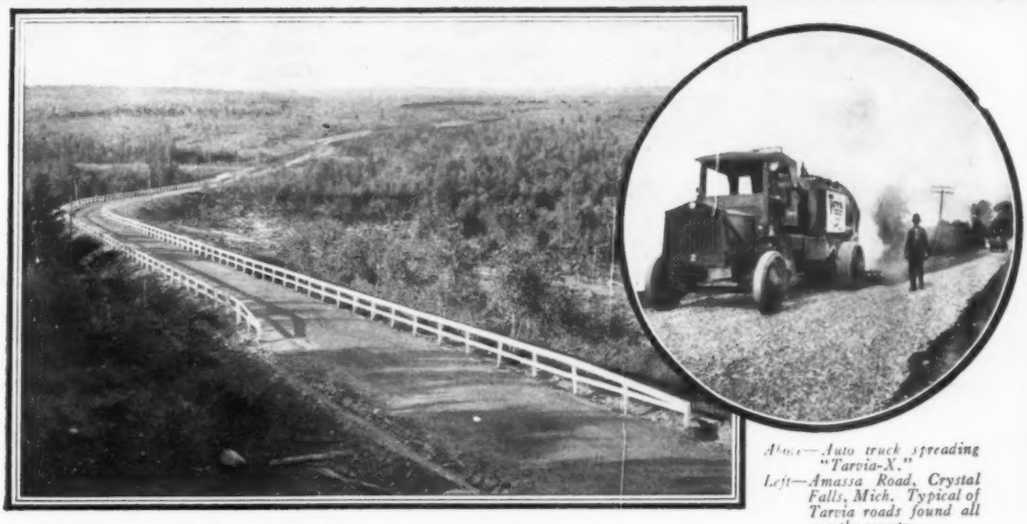
# PUBLIC WORKS

CITY COUNTY STATE

*Illustrated booklets showing pictures of Tarvia roads in various sections of the country and descriptive of the different methods of applying Tarvia, will be sent free on request.*



*Above—Auto truck spreading "Tarvia-X."*
*Left—Amassa Road, Crystal Falls, Mich. Typical of Tarvia roads found all over the country.*

## The Country Wants Good Road *Mileage*—

"GOOD ROADS at *any cost*" is a mistaken policy. Good roads cease to be a benefit when the expense of building and maintaining them becomes burdensome. Costly construction slows up the proper development of any good roads program.

What the country wants and needs is greater *mileage* of moderate-priced, low-maintenance all-year highways. Hundreds of towns and counties have found that Tarvia roads squarely meet this demand; that they are the economical solution of the good roads problem—satisfactory alike to road officials and taxpayers.

For Tarvia roads are not only firm, smooth, dustless and mudless all the year round—they are far less costly to build than any other type of modern highway, and far less costly to maintain. Because of these economies, the use of Tarvia insures the most miles of good roads that can be built and maintained with the road funds available.

The granular surface of a properly constructed and properly maintained Tarvia road prevents skidding

"Tarvia-X" is a dense coal-tar preparation which has been proved by experience to be the most durable bituminous binder for road construction. Other grades of Tarvia are made for preserving and patching all kinds of hard surface roads.

# Tarvia

***For Road Construction Repair and Maintenance***

New York Detroit Bangor | Chicago New Orleans Youngstown | Philadelphia Birmingham Toledo | Boston Kansas City Columbus

The Barrett Company

St. Louis Minneapolis Richmond | Cleveland Dallas Baltimore | Cincinnati Salt Lake City Omaha | Pittsburgh Atlanta Houston Denver

THE BARRETT COMPANY, Limited. Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S.

# A Clean City for 1923

## A Good New Year's Resolution For Every City Official

Clean streets are without doubt one of the greatest single attractions your city can offer, both to its own inhabitants and to visitors. They are like good clothes in that they don't so much call attention to themselves as create a most favorable general impression. The problem of how to secure the cleanest streets for the least money is, therefore, one that is interesting city officials these days more than ever before.

## LET US MAKE IT EASY FOR YOU

The Austin Organization has given street cleaning special study for more than a quarter of a century, and as there are as many Austin Sweepers of all styles in use today as all other makes combined, we feel qualified to speak with authority when we say that

## An Austin Motor Pickup Sweeper Will Solve Your Problems

Because it is constructed along the lines accepted as standard by all leading manufacturers of motor driven equipment.

Because it is easy to operate, does perfect work, and is by far the most economical method yet devised for cleaning paved streets.

*Right now is not a bit too soon to decide what you are going to do about this problem. If you feel handicapped by your present equipment, write and ask us to send one of our sweeper experts to help you select the right equipment to make your city a clean city for* 1923.

## The Austin-Western Road Machinery Co.

**CHICAGO, ILLINOIS**

***Branch Warehouses and Service Stations***

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|---|---|---|---|---|---|
| **Albany** | **Columbus** | **Kansas City** | **New Orleans** | **Portland, Ore.** | **St. Paul** |
| **Atlanta** | **Dallas** | **Little Rock** | **New York City** | **Richmond** | **Topeka** |
| **Billings** | **Denver** | **Los Angeles** | **Oklahoma City** | **Salt Lake City** | **Wahoo, Neb.** |
| | **Jackson, Miss.** | **Nashville** | **Philadelphia** | **San Francisco** | |


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# PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 54 March, 1923 No. 3


# Developments in Earth Excavation


By Geo. B. Massey, M. Am. Soc. C. E.*


**Modern machinery saves labor, eliminates operating delays, and can be obtained of any desired capacity, for heavy or light excavation, trenches, etc. Hydraulic excavators. Draglines. Internal combustion engines for power.**

It does not seem as though men could go on year after year improving the methods of handling dirt. But they do. And these improvements, which originate for the most part in this country, are immediately investigated and adopted abroad.

STEAM-SHOVEL WORK

A few years ago most of the heavy earth excavation was made by the standard two-truck, railroad type of steam shovel, running on short sections of standard gauge track and loading dump cars which were hauled by steam locomotives to a dump. Here the cars were dumped by hand, and a large force of men dug away and pushed the dumped material over the edge of the dump and then worried the track over to the edge.

*Member Randolph-Perkins Co., Engineers. Author of "Engineering of Excavation."

Around the shovel were the pitmen who brought up the track sections, laid them and connected them up, placing rail clamps and handling the jack-screw pads in moving ahead. It required from four to six men.

Now, if a standard railroad type of shovel is used, it is mounted on canterpillar traction and therefore requires no pitmen or jacks, the moving up being handled entirely by the shovel runner.

This eliminates four to six men in earth excavation.

The locomotives, if not large, are very apt to be driven by gasoline engines and a logical further development will be locomotives driven by heavy oil engines.

The cars, if not too small, are dumped by air and the dumped material is scraped to the edge and over

TRACTOR HAULING FOUR-WHEEL SCRAPERS

the edge of the dump by a very powerful, all-steel spreader plow which will maintain a level top along the dump up to twenty-three feet in width so that the track moving has to be done very seldom and then is done with a track-shifting machine.

Thus are eliminated pitmen about the shovel, delays due to moving up, delays for coaling the engine, men to dump the cars and the large force necessary to prepare the dump for dumping further trainloads.

As a matter of fact, the railroad type of shovel has long been largely superseded by the revolving shovel which is built to carry dippers running all the way from one-half cubic yard to seven or eight cubic yards, with no mechanical reason why they cannot be increased considerably above that.

The advantages possessed by the revolving shovel is that it can dig anywhere and dump anywhere in the circle and therefore does not have to be run back for a new cut with loss of time.

The development therefore has been consistently along the following lines:

1. Eliminating common labor wherever possible.
2. Eliminating delays in operation.
3. Increasing the capacity of the machinery.

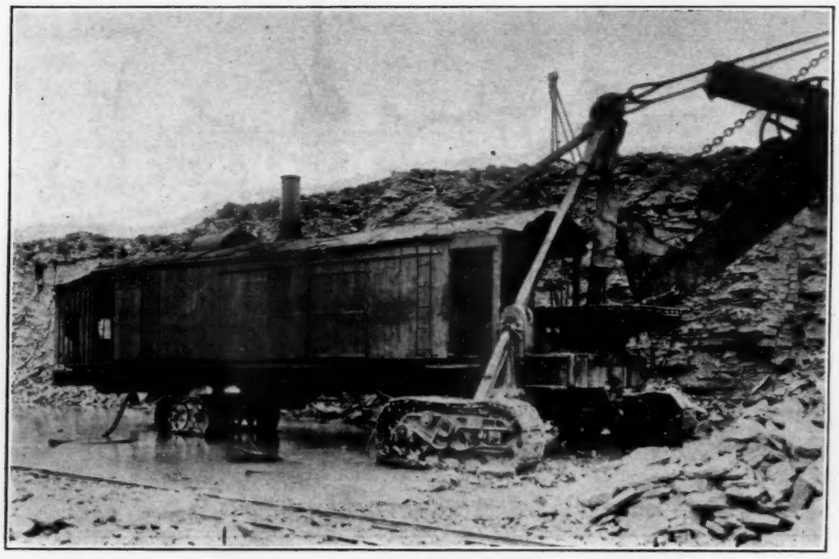
There has also been a very pronounced improvement in the revolving shovels in that they now can be altered in the field at very slight additional cost so as to become a dragline machine or a crane, a clamshell machine or a pile driver.

The use of gasoline or oil engines on these machines does away with the fireman and the use of caterpillar traction does away with the man on the ground to handle the pads. An improvement has been made recently in the operating levers, making it much easier on the runner.

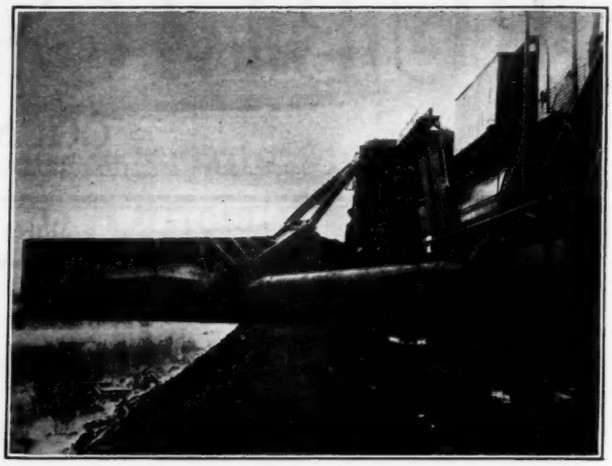
Excavating problems are receiving more expert study than formerly, resulting in special methods being devised for individual cases, taking fullest advantage of local conditions.

### USE OF WATER

Thus, where practicable, advantage is taken of the excavating and transporting possibilities of water.



RAILROAD TYPE OF SHOVEL, FULL CATERPILLAR TRACTOR



HEAVY SPREADER PLOW FOR HEAVY EARTH FILL

Monitors are installed for excavating and centrifugal pumps for transporting the excavated material to the spoil area.

Or the earth is excavated by machinery and transported by water.

The writer made use recently of pressure water available near the work to move eighteen thousand yards four hundred feet, by means of a hydraulic elevator installed on a small barge, at a cost which worked out much less for equipment and operation than any method which could have been employed.

In this field, pumps are being improved and are being driven by oil engines. The quality and therefore the life of pipe has been improved.

A feature of interest developed by the Miami Conservancy District at Dayton, Ohio, was a white iron centrifugal pump shell. This result was obtained by chilling the casting in the mold after it had been poured, thus giving a very hard, white iron at the wearing surface and for a considerable distance back into the shell. A test of this pump shell showed that it had worn only one-fourth of an inch after pumping 110,000 cubic yards of sand and gravel. It was estimated that this meant a total pumping duty of 400,000 cubic yards for this shell. A grey iron shell had given a total life of 160,000 cubic yards and manganese steel shells from 134,000 to 182,000 cubic yards. The long life of the chilled cast iron shell was partly due to the design and partly to the fact that the cast iron can be cast in thicker sections than the manganese steel.

The Miami Conservancy District made considerable use of a stream of water flowing over the ground at a velocity sufficient to move earth, gravel and cobbles. This process is called sluicing and consists in so directing the stream of water that it will undercut a bank and then carry away the material which caves into the steam.

ELECTRIC SHOVEL LIFTING TEN TONS THROUGH 65-FOOT ELEVATION

In breaking down banks with a hydraulic monitor, it often happens that the water required for the monitor is not enough to carry the broken down material through the centrifugal pumps and piping to the dam or spoil pile. Extra water at low pressure is supplied to the sump for this purpose and can be used to supplement the work of the monitors in breaking down material and carrying it to the sump. This makes possible carrying on the monitor operations at a greater distance from the sump than would be possible otherwise. Incidentally, it has been proved that the quickest and cheapest way to thaw frozen ground is to direct a stream of flowing water across the frozen area.

### LIGHT EXCAVATION

Heretofore we have considered only bulk excavation. There are many cases where the work is of so little volume that it does not pay to use the customary types of excavating machines. In the old days, this called for teams and slip scrapers, the larger the work or the longer the haul, the greater the number of teams used.

At present there are two types of equipment which are used to the best advantage. Where the haul is not very long, four-wheel scrapers are hauled in a train by a caterpillar tractor. They are self-filled by men lowering the cutting edge into the work and are dumped by men at the fill or spoil pile.

For a longer haul, the excavating is done by an elevating grader hauled by a tractor, the grader loading trailers which are hauled by another tractor. Loading goes on while both tractors are in motion.

The advantage in the grader and trailers over the four-wheel scrapers is that the load pulled by the tractor is, in the case of the scrapers, the pull occasioned by loading the scrapers, while, in the case of the trailers, it is the pull required to move the trailers, which pull of course is less. Thus a larger amount of material can be transported by each tractor. The trailers spill less material than the scrapers and a shorter train will be required.

Where the cut is short, the scrapers have the advantage, as all of the scrapers can be loaded as each passes through the cut, while the grader continues in motion while loading trailer after trailer.

In skimming jobs, where the material is not carried away, but is deposited alongside the cut, a long-boom revolving shovel can often be used to advantage and will dispose of the material without transporting equipment being required. It will also leave a very good surface.

### DRAGLINE MACHINES

A small dragline machine will have a longer working diameter from digging to dumping point and will leave a fairly good surface. The dragline machine has consistently increased in popularity since its introduction. By dragline machine is meant the revolving self-contained machine and not the so-called dragline machines which are better described as tower machines.

The dragline machine has so many advantages that it should have been developed years before it was. Its principal advantage is that it digs below the surface upon which it stands and dumps above the surface so that there is obtained a very high lift when compared with any form of shovel.

The second advantage is that none of the digging strains are transmitted to the boom, so that it can be made light and long, thus giving a long diameter from digging to dumping.

The body of the machine occupies a central position with regard to the vertical and also the horizontal movement of the load when both are extreme. This is an ideal condition.

Draglines can work almost independently of drainage, as water does not affect the operation except in very light material.

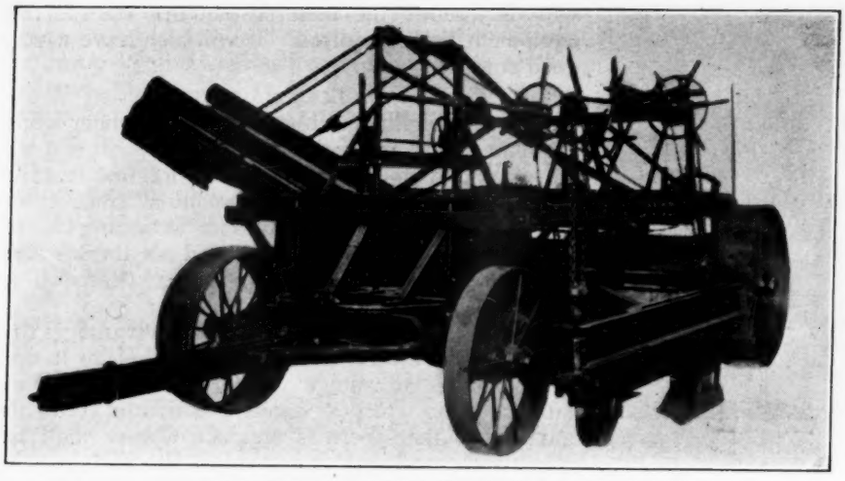
Another advantage is that the dragline machine moves back away from its work and can maintain a suitable distance and a suitable slope between the machine and the cut to suit any class of material so as to obviate caving.

### DIGGING TRENCHES AND CELLARS

In digging trenches for sewers or other pipe there has not been so much improvement as in other lines. The machines which survive are still the wheel type and ladder type with multiple buckets and also the small revolving shovel with long handle and special sewer bucket which is particularly effective in digging around buried pipe or other obstructions.

For cellar excavation, nothing has been found to be superior to the small revolving shovel. More and more of them are being used with a long boom, as the digging usually is fairly easy and it obviates

DRAGLINE MAKING A DEEP EXCAVATION
About 59,000 cubic yards removed from a channel 75 feet wide and 22 feet deep in 138 nine-hour shifts (two shifts per days) using a P. & H. No. 206 ¾-yard dragline



"WESTERN" EXCAVATOR AND LOADER

bringing the wagons or trucks into the excavation to load. Trucks are replacing wagons very largely. Small draglines have been used to some extent but they do not leave as good a bottom, do not swing so fast and do not dump as accurately. The shovel can dig more exactly to lines and leave fairly vertical walls.

All small shovels can, or should, climb out of an excavation on a very steep slope.

Most excavating machines are now mounted on caterpillars as the extra first cost has been proved to be offset many times by the reduced operating costs. The modern caterpillar is made up entirely of high-grade steel castings so that it can safely ride over or crush anything in its path.

Considerable effort is being made at present by engineers and builders in the application to excavating machines of internal combustion engines using the heavier grades of oil. The writer has designed a drive for an oil engine on a dipper dredge which is now being tried out. A great many obstacles have to be met and overcome in any design using a heavy oil engine for intermittent loads. An oil engine cannot be overloaded as a steam engine can, and cannot be allowed to stall, as is frequently the case with a steam engine.

The tower machines have a field in which they can operate very cheaply. This is in borrowing material over a large area and delivering it accurately placed at one spot, as is done in building levees along the Mississippi river. These machines handle seven or eight yards at a time over spans as high as six or seven hundred feet at an extremely low cost. The latest machines have both head tower and tail tower mounted on caterpillars. There is little control while digging, but extremely accurate control in dumping and the action of the bucket is such as to compact the material in the act of dumping.

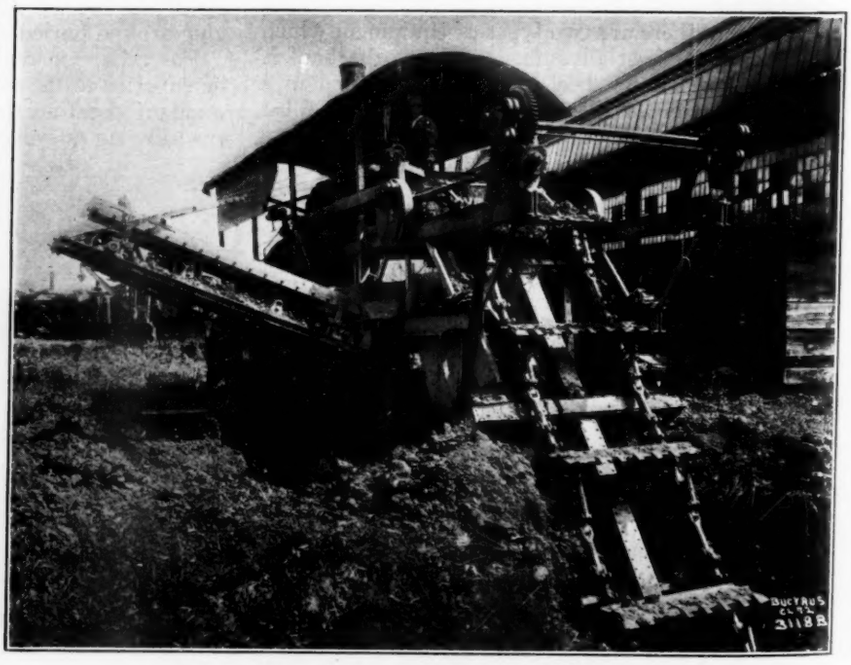
The very large stripping and mining operations on the iron range and the low-grade copper properties, as also coal stripping and large quarry and gravel banks, are the most important examples of excavating and handling large quantities of material and the development here is universally in the adoption of the large revolving shovel operated by electricity.

In fact, steam plants on portable excavating machines are so notoriously expensive to operate, that electricity, gasoline engines or heavy oil engines are being installed in new equipment of all types and sizes.

## Tunneling the Hudson River

Commuters and others travelling through the Metropolitan district in and around New York have become accustomed to underground travel and in fact the greater part of the local traffic is by underground routes. There is, therefore, nothing especially novel to them about crossing the Hudson river by tunnel rather than by ferryboats or bridge; in fact, they have been doing so for years. But the remarkable feature of the tunnel now under construction is that it is a vehicular tunnel, the first of the kind to be constructed in New York and vicinity.

So thoroughly sold, however, are the people and the capitalists of the city on the idea of



BUCYRUS TYPE OF TRENCH EXCAVATOR

the vehicular tunnel that already, now that the physical practicability and success of the first vehicular tunnel seems to be assured, two more are planned, one to cross the river opposite the upper part of the city, while the third tunnel is planned to be located between 23rd and 42nd streets, New York, to tap the heavy traffic from the middle of Manhattan Island. This tunnel is planned to be built with private capital and to reimburse the investors of the capital by the tolls collected, with the privilege of permitting the states to purchase it after five years, the tunnel to revert to the states after fifty years.

## Wisconsin Highway Prices

Bids were received in February for several contracts for road work in Wisconsin totalling nearly $300,000. One of these was for a road in Walworth County, let to Fess & Fess at the following prices:

Earth excavation, 79c a cubic yard; loose rock $1.24; borrow 84c; ditching 85c; concrete surfacing $1.49 a square yard; cement in place 25c a barrel; Class A concrete in culverts $25 a cubic yard and in bridges $28 a cubic yard; storage of cement 10c a barrel; reinforcing steel in place 3½c a pound; total contract, $84,889.

Another road contract was let to R. R. Birdsall of Racine at the following prices: Earth excavation 99c a cubic yard; concrete surfacing $1.30 a square yard; cement in place 30c a barrel; concrete, Class A, in culverts $23 a cubic yard and in bridges $28; combination curb and gutter 50c a lineal foot; guard rail 60c a lineal foot; storage of cement 30c a barrel; steel reinforcing, in place, 4½c; 6-inch drain tile 25c a lineal foot; total contract, $113,210.

## Garbage Disposal in Cleveland

The city of Cleveland has adopted its annual appropriation ordinance and in this we find that it anticipates for the year 1923 a revenue from the sale of garbage grease of $200,000, from the sale of tankage of $56,500, from the sale of waste paper $1,350 and from scavengers' privileges $1,920.

The receipt from garbage grease and tankage of $256,500 has a very attractive look, but turning to the appropriations we find that the budget allowance for garbage collection and disposal totals $1,087,107, or more than four times the receipts.

This total estimated expenditure comprises $795,621 for salaries and wages, $185,786 for supplies, $5,000 for maintenance of buildings and structures, $43,500 for maintenance of equipment, $51,200 for miscellaneous services, including $12,000 for insurance, taxes and rents, and $6,000 for new equipment.

## Highway Work in New York

Reporting on conditions of highway contracts in New York State, Colonel Greene, the new highway commissioner, recently stated that there are in force 203 unfinished contracts for constructing and reconstructing 851 miles of roads, on which less than 35% had been paid for work performed up to March 1, 624 miles of pavement remaining to be laid. In addition, contracts had been let for 537 miles of pavement, which is 145 miles more than were built during the entire season of 1922. Of the contracts let in 1922 less than 105 miles have been completed and only 13 miles have been finally accepted. There are 88 miles of pavements still to be built on contracts carried over from 1921.

From these figures it would appear that New York State will do a good season's work if it completes the contracts already made without entering into any others this year.

A new section for concrete has been adopted by Commissioner Greene, having a parabolic top surface and a straight slope from each edge to center, with a thickness of 7 in. at the edges and 6 in. at the center. The weight of the reinforcing mesh is cut down to 40 pounds.

## North Carolina's Highway Program

The 1923 highway construction program in North Carolina was put under way February 1 when bids were opened on over two hundred miles of road work. Plans for 1923 call for the awarding of approximately 800 miles of work.

## Checking Grades in Steam Shovel Work

One of the problems for both engineers and steam shovel operators to get together on in any job is the placing and maintaining of grade stakes and securing of a fairly uniform grade by the shovel. The following suggestions for the shovel operator are given in the "Excavating Engineer":

When you start in on a cut you are ordinarily sure of your grade. It is only later that you might begin to be doubtful as to how you are holding it. When you have obtained your grade, therefore, thrust the dipper of your shovel out to the stops and drop it to the ground, then have someone measure with a string the length of rope you have out between the pin of your padlock and the center of your point sheave on the boom. Make note of this figure. It is obvious that if you are not keeping to this grade you can tell by measuring your rope again and comparing it with your first figure, providing you do it before you have moved up. If this figure is greater you are taking too much of a cut; if it is less you are taking too thin a cut.

It is not difficult for a shovel runner to work up a table of such figures for the usual grades, which will prove of great assistance to him in the future.

Another variation of this method is to tie a piece of string around the hoisting rope where it touches the sheave on the point of the boom. Any variation from your grade may be noted by watching this string and noticing its position relative to the sheave. These methods are both rough, but they are good.

# Constructing Earth Dams in Vermont

**Two dams, one two hundred feet high, built for the New England Power Co. with cores of fine material deposited by hydraulic method between embankments of earth brought in dump cars.**

While dams built in the mountains of New England have probably, in the majority of cases, been of concrete or stone masonry, large earth dams are being built in Vermont by the Power Construction Company in developing hydroelectric power on the Deerfield river for the New England Power Company, of which it is a subsidiary. In fact, one of these dams which is now under construction, is one of the largest earth dams in the country, having a height of more than 400 feet above the bed of the stream and a maximum width at the bottom of about 1,500 feet.

### THE SEARSBURG DEVELOPMENT

The Searsburg development consists of an earth dam across the Deerfield river west of Brattleboro, nearly four miles of wood stave conduit with a surge tank where this joins the steel penstock, and a power station. The river valley at the site of the dam is comparatively narrow and the banks have slopes as steep as 1:1 in some sections. The river has apparently changed its channel across the valley from time to time and the ground is found to consist largely of clay containing a number of large and small boulders. The east end of the dam connects with clay soil, but the west end abuts against a ledge which is utilized for constructing the intake and spillway in solid rock and for the location of a temporary by-pass.

The dam is 50 feet high at the highest point, 20 feet wide at the crest and about 240 feet at the lowest point. The earth section is about 200 feet long and the spillway about 350 feet. About 55,000 cubic yards of earth were required for the dam, which was obtained from borrow pits on the hills on the east end of the dam, at a higher level than the dam and about a quarter of a mile from it.

The chief feature of this construction that is in any way notable is the method of combining dry and hydraulic fill. Two dry embankments were carried up, one forming the downstream slope and the other the upstream, and between these a core of fine material was constructed by the hydraulic method.

The dry fill was made by dumping from two temporary trestles placed about 100 feet apart. These trestles were built of timber cut from the vicinity of the dam. The material, a mixture of clay and gravel, was excavated by a revolving steam shovel with a 1½-yard bucket which deposited it in 4-yard dump cars. These cars were handled on 30-inch gauge track by locomotives in two trains, which were able to handle the material as fast as it was excavated by steam shovel. The outer slopes of the two embankments were made 10 per cent. steeper than designed for the final slope in order to provide for future settlement.

When the fill had reached a height of about 15 feet the dry filling was discontinued and the ground surface between the two embankments was cleared, all boulders and river silt being removed down to hard pan, this forming a foundation for the watertight core. Depositing dry fill in embankment was then resumed, but the finer material deposited on the inner slopes was washed down into the middle of the dam by means of two fire streams that were operating continuously. As the fine material was washed down into the center between the embankments a pond was formed in which the material settled. The water was re-pumped from this pond into the lines of hose used for washing the fine clay from the sides of the embankments, a 2-stage electrically driven pump floating on a raft in the pond being used for this purpose. Additional water, of course, was required to make up for leakage from the pond, and a 6-inch single-stage pump supplied water from the river above the dam for this purpose. The hydraulic fill core obtained by this method was carried up only to

EXCAVATING EMBANKMENT MATERIAL, DAVIS BRIDGE DAM.

MAKING DRY FILL, DAVIS BRIDGE DAM.

the grade of the spillway, which was about 15 feet below the crest of the dam.

The hydraulic core was carried into a trench extending for some distance into the east bank of the river. To tie the core to the rock ledge at the west side, this ledge was cut to a vertical face and an abutment built against the face with buttresses or short core walls extending from the abutment into the hydraulic core to prevent leakage between the fill and the concrete abutment.

Preliminary to making the earth fill, a temporary bypass was made by blasting out a channel in the ledge on the west end of the dam behind the abutment. The upstream embankment dammed up the stream flow until it reached the elevation of this bypass, which carried the ordinary flow during the remaining construction of the dam.

This work was done by the Aberthaw Construction Company and was completed in the Fall of 1922.

"DAVIS BRIDGE DAM"

In the meantime the Power Construction Company had begun another development on the Deerfield river near Whitingham, which is considerably larger but will be carried on in much the same way; that is, by building two embankments, one at the upstream and the other at the downstream side, and then building an impervious core between these by hydraulic methods. This dam, known as the "Davis Bridge Dam," will be 204 feet high from the river bed to the crest, 1,500 feet in maximum width at the bottom, 25 feet wide at the crest and 2,000 feet long at the top. Nearly 2,000,000 cubic yards of material will be required for this dam. Work on this development was started April 23, 1922 and the contractor, W. F. Carey Company, Inc., has contracted to complete the work by the end of this year so that the spring freshets of 1924 may be impounded behind it.

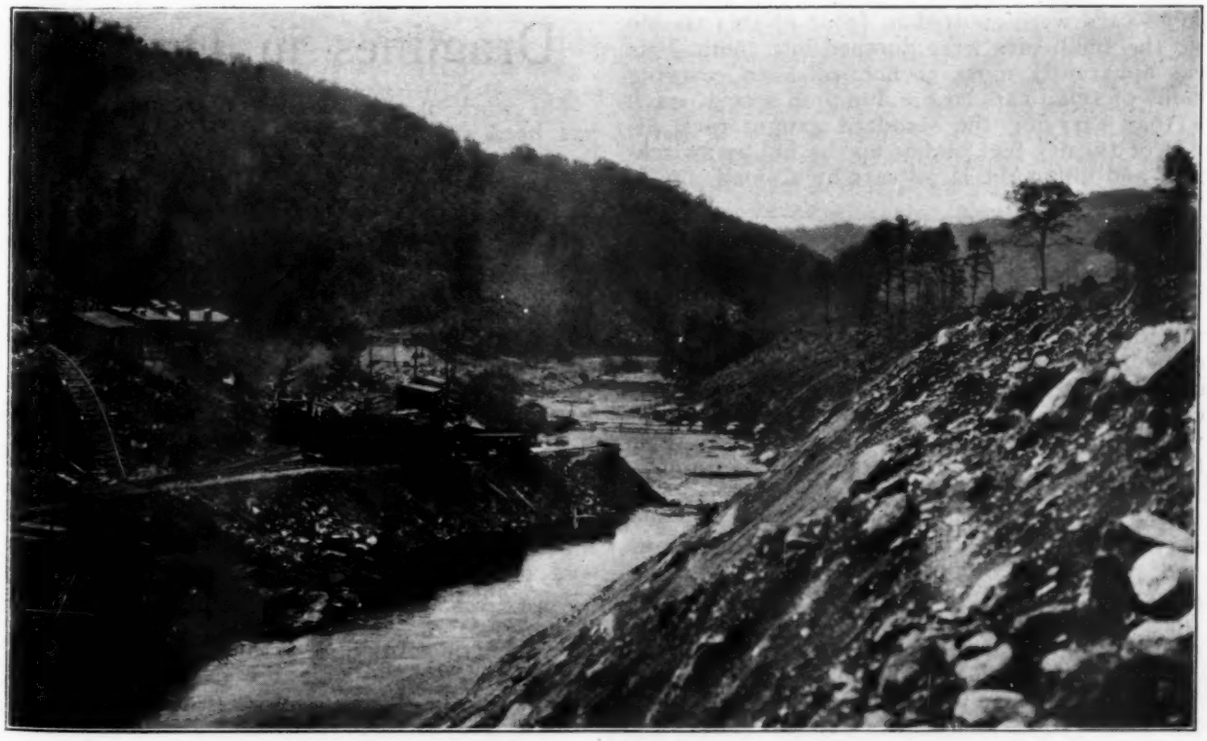
The upstream slope of this dam is 3:1 for 100 feet below the crest, 3½:1 for the next 50 feet, and 4:1 for the remainder of the slope. On the downstream slope the top 100 feet is 2½:1, the next 50 feet 3:1 and the bottom 50 feet or more 3½:1.

As in the Searsburg development, dry embankments are being carried from one side of the valley to the other both above and below the middle of the structure, thus forming practically a cofferdam. The middle 300 feet of the dam will then be cleared of all boulders, stumps and loose material and a trench 50 feet wide and about 15 feet deep to hard clay bottom will be carried entirely across the valley and into the hills at the ends to receive the foot of the hydraulic fill core wall.

This core wall will be made in the same way as in the dam first described, by washing the fine clay from the inner slopes of the two embankments and allowing it to settle in the pool in the center of the dam. In this case it is intended to provide two pumps on pontoons for pumping water from this pond to the hose used in washing in the fine core material.

A diversion tunnel 1,500 feet long has been constructed by the Rollin Construction Company for carrying the river around the dam. Part of this tunnel will be used as a spillway.

The river, after leaving the dam, winds around a mountain and the power house will be on the other side of this mountain and water will be

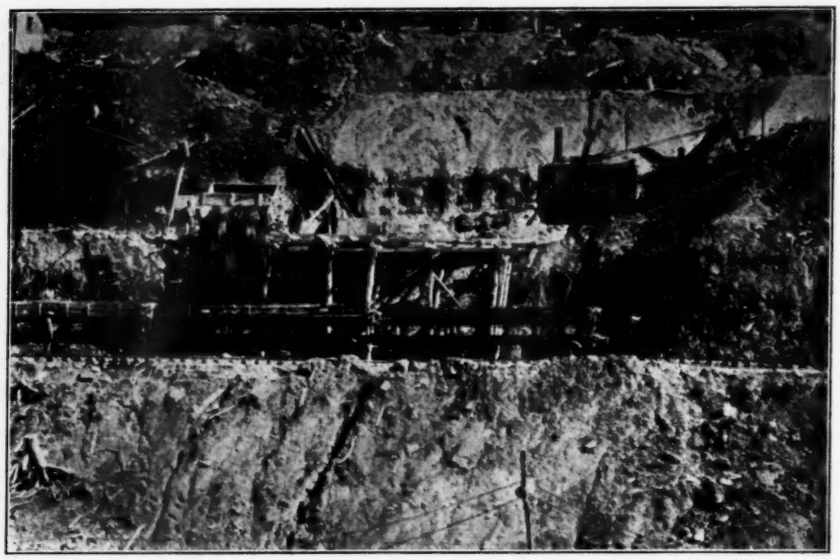


SITE OF DAVIS BRIDGE DAM, DECEMBER, 1922

led to it from above the dam by a tunnel through the mountain, which construction will add greatly to the available head. This tunnel was started last September.

One of the principal difficulties in constructing this dam is in finding the enormous amount of material required for building it in a country where the earth overburden is not ordinarily very deep. Some of the rock taken from the two tunnels is being used in the embankment. In addition to the rock, numerous boulders, both large and small, are found in the earth excavation.

Bucyrus steam shovels are used by the Carey Company, and last October a Bucyrus dragline, which had been used by that company in phophate operations in Florida, was brought up for this construction, having a 100-foot boom and a 3½-yard bucket. Most of the material excavated is dumped into standard-gauge dump cars manufactured by the Western Wheeled Scraper Company, which are hauled in trains by American locomotives and dumped, making the embankments for the dam. One interesting variation was noted in handling the rock from the penstock tunnel. This material last September was being loaded by a small steam shovel into 4-yard Western dump cars and these small cars were hauled by horsepower a short distance onto a temporary trestle built alongside of a standard gauge track at a lower level. Standard gauge cars were spotted in front of this trestle and the small cars were dumped into them. This was apparently more economical than carrying trains of small cars to the dump on special track or than carrying the standard gauge track fifteen or twenty feet higher up the hill by switchback and filling the large cars by a small shovel.



SMALL CARS DUMPING INTO LARGER ONES.

## Cost of Excavating Sandstone

J. S. Walton, of Brandenburg, Kentucky, gives the following as actual costs, with no profit included, of taking out sandstone in a small road cut in Kentucky where the nature of the work called for a team outfit for the earth work and with the rock so scattered that it was necessary to take it out by hand and teams.

He used a portable air compressor, gasoline driven, with jack hammer. The sandstone was very difficult to drill, being mixed with dirt seams and, on account of the sharp grit, was very destructive to drill steel and necessitated frequent sharpening. It was found necessary to space drill holes more closely and give heavier charges of powder than when taking out hard limestone. The haul was very favorable and averaged about 250 feet. Eight hundred and eleven cubic yards of material were removed at the following costs:

| | |
|---|---|
| Supt., labor and teams | $1,040.77 |
| Insurance | 35.39 |
| Cost of dynamite, caps, transportation and storage of same | 307.81 |
| Use of compressor, freight, etc | 128.92 |
| Sharpening steel | 44.85 |
| Total | $1,557.74 |

This gives an average of $1.92 per cubic yard without profit or overhead charges.

The above information was furnished to "The Scraper," the journal of the Kentucky Association of Highway Engineers.

# Draglines in Dayton

The work of the Miami Conservancy District has been practically completed insofar as the five dams and other large work is concerned, although some small jobs in the cities still remain. In looking over the records of the construction work one is impressed with the very general use made of draglines. For instance, in the reconstruction of the channel through Dayton the dragline was used almost exclusively, the greater part of the work being done with the two largest draglines used, Class 175 Bucyrus. These machines weigh 225 tons, the booms are 125 and 135 feet long, the buckets hold 3½ to 4½ cubic yards and the reach in a 180-degree turn is 250 to 270 feet. These draglines are operated by electricity. These two large machines were supplemented with two smaller ones, a Class 9½ Bucyrus steam machine and a Class K Lidgerwood electric. These machines did the odd jobs that the big machines did not have time for or were too large for.

Along one stretch of the river no waste land could be found for dumping the excavated material, and for transporting it an unusual scheme was employed. A temporary dam was built across the river giving 10-foot depth of water

in the improved channel and in this one of the big dragline machines was floated on a scow and the material excavated by it was loaded onto other scows which were then carried some distance in the slack water to spoil banks, where they were unloaded by another machine. Further up, where it was impracticable to provide slack water for floating equipment, the material was carried to the spoil banks by standard gauge locomotives hauling air-dump cars.

In the lower part of the city the channel runs through low land and more than 1,000,000 cubic yards of material taken out of this section was used for levees and filling behind them. The general plan was to start a dragline down the center of the river, excavate the material and deposit it in a windrow as far toward the river bank as the machine would reach. Later the same machine or another would pick up this material, swing round in a half circle and deposit it in another windrow. It was found cheaper to make three windrows with the dragline machine than to load and transport the earth; it was usually necessary, however, to make only one or two throws to get the material into final position.

More than 2,000,000 cubic yards was taken out of the river channel and 129,000 cubic yards was taken from borrow pits for levee work. To accomplish this the draglines travelled up and down and across the river a total distance of over 33 miles. On Wolf Creek, a tributary of the Miami, much of the levee work was done with a small dragline.

In Hamilton, also, draglines were much in evidence. Last year an electric dragline, a Class 14 Bucyrus caterpillar dragline, a Class 14 Bucyrus mounted on rollers and a Model 21 Marion dragline were all at work at different points in the river through the city, grading roadway approaches and doing other earthwork. In fact, the reports of the Conservancy District mention little equipment other than draglines used in any of the large jobs of earth handling connected with the channel improvement.

## Rapid Transportation of Track-Laying Apparatus

The advantages of track-laying apparatus such as steam shovels, concrete mixers, etc., are many and well known, but they generally are incapable of anything like speed. While they can move rapidly enough in connection with the work which they are performing, it is sometimes desirable to transport them from job to job at a considerably greater speed.

To effect this, a contractor of Los Angeles, E. E. Schilling, has built a special truck for carrying a 30-B Bucyrus shovel from job to job. A trailer has been built consisting of two trucks connected by a pair of I-beams sufficiently strong to carry the shovel and mounted at such heighth that, when the shovel is resting upon them, the continuous track is raised a few inches above the ground. In order to get the shovel on to the trailer, a pin in the front truck of the trailer is removed and the truck pulled out of the way while the front ends of the I-beams rest upon the ground. Blocking is placed on each side of the I-beams so that the shovel can be run by its own power on to the blocking and straddling the I-beams. The I-beams are then raised to position and connected again to the front truck after which the shovel propels itself forward and the truck is at the same time pulled forward, the shovel thus running off of the blocking until it rests upon the trailer. It is said that it takes about fifteen minutes to load the shovel upon the trailer in this way.

## Standardizing Shovels

At a recent meeting of the Associated General Contractors the proposition was advanced of standardizing the ordinary hand shovel. As an indication of the importance of the subject, it was stated that ten million shovels are sold in the United States per year and that any partial failure of these shovels to develop their full efficiency as to life, or the full efficiency of the laborers using them, totals to large figures.

The points mentioned as entering into the specifications to be standardized are the length and gauge of the blade, length of handle, lift of blade, quality of steel, surface of blade, shape of blade, socket straps, balance in the hand and brand. The blade lift or distance of the center of the blade above the floor when the shovel is lying flat, determines the height of the handle above the ground when the shovel is entering the ground at a given angle, and this is of course important as regulating the position of the shoveller when using the shovel. If the gauge of steel used is too heavy, the shoveller employs an unnecessary amount of work in handling the shovel, while if it is too light, it of course wears out too quickly. A change of one gauge adds about four ounces to the weight of the shovel. The surface of the blade may be that of the sheet iron from which it is cut, and if it is unpolished is not so apt to rust quickly as if it is polished, but if the surface is polished smooth the shovel will enter the earth more easily and give a greater output per man-hour. Polishing costs the contractor about $1.50 per dozen. Hollow-back blades are likely to accumulate dirt, which adds that much extra weight to be handled with the shovel, and thus the shape of the blade is important.

In the matter of maintenance of shovels, it was stated that a shovel should be cleaned after each day's use and oiled to avoid pitting and rusting. It should be sharpened with a file or emery wheel as often as it gets dull. The area of the blade and consequently its approximate efficiency is decreased about 5% by the wearing off of one inch of the end of the blade.

It was stated that the output of a shoveller can sometimes be increased ten to twenty per cent by giving him a shovel of better quality or shape. There are perhaps two thousand variations in shovels manufactured today and it was believed by the speaker that a great many of these were wasteful of energy and should be entirely eliminated and that shovel designs could be cut down to a very small percentage of 2,000. As an illustration of what is

possible, the case of the wheelbarrows has been cited where styles have been cut down from 165 a few years ago to 30 at the present time.

# Storing Contractors' Equipment

**Some suggestions for the storing of equipment to prevent deterioration and malicious damage while idle.**

"It is not reasonable to expect that if you dump a timber derrick on the ground with all the metal parts attached and make no effort to protect either metal or timber from the elements you can go out in the Spring and find your derrick all shipshape and ready to set up ready for work. Even if nothing has been stolen, the timbers are liable to be chipped and warped, the metal parts rusted and the sheaves seized on their shafts." Thus does the "American Bulletin" begin a brief article offering advice to contractors to properly store their equipment. The Bulletin then goes on to describe a good example of satisfactory storage at moderate cost, which description may be condensed as follows:

The George J. Grant Construction Company at St. Paul uses for storage a level, sandy tract, from which the company had previously removed about 500,000 cubic yards of sand and gravel down to the street level. A section of this tract was leveled off and storage sheds erected. The sandy soil afforded good drainage and the plot was located convenient to railroads and paved streets. Here the company has built carpenter, machine and blacksmith shops, tool house, garage and storage sheds for derricks, hoisting engines, etc. A stiff-leg derrick handles heavy pieces.

The company owns twenty-five stiff-leg derricks and these, on arrival for storage, are taken apart and given two coats of white lead mixed with enough lamp black to produce battleship gray. All the metal parts are removed and thoroughly oiled, marked and stored in the tool house while the timbers are stored in a shed 150 feet long, 50 feet wide and open at the ends to permit ventilation and teams and trucks to drive through. This shed is of wood with corrugated iron sides, the roof covered with roofing paper. The main upright posts supporting the shed are 14x14 inches and support five iron cross beams to which a hand-power crab is attached for loading and unloading the timbers. The timbers are piled on five large iron beams as sills, while five 2x4s are placed between each two tiers to insure ventilation. Care is taken to so place the timbers that any sag or belly acquired in service will be corrected by the weight of the timber.

Hoisting engines are taken to the machine shop, knocked down and overhauled by machinists who are familiar with them. All fittings are removed and covered with heavy lubricating oil and packed in marked and numbered boxes so they can be found readily. Bearings are oiled to prevent rusting; the cylinder head is removed and the cylinder wiped dry on the inside and coated with oil; while packing is removed from the stuffing boxes to keep the rods from rusting. All bright parts of the engine are slushed with heavy grease or, if the machine is to be kept in storage for some time, a mixture of white lead and tallow melted together, which stays in place better than grease and can be removed readily with kerosene. The boilers and frames are stored in a weather-tight shed 400 feet long and 50 feet wide, covered with corrugated iron and substantially built to keep out prowlers. Before the boilers are drained, a quantity of crude oil is put on top of the water, which is then allowed to run out slowly, a coating of oil being thus left on the tubes and plates. In this same shed are stored dinkey locomotives, concrete mixers, gasoline engines, etc.

The cabs of steam shovels stored in the yard are made as weather-tight as possible and all small parts are removed and stored in the tool house. Form timbers, wheelbarrows and similar equipment are stored in the open but are stacked so as to minimize deterioration. Shovels, picks, hammers, wire rope, blocks, etc., are stored in the tool house, every piece being cleaned and oiled. Clips are removed from the wire ropes, cleaned, oiled and the nuts worked back and forth a few times to make sure that the oil covers the threads of the bolt. Sheaves are cleaned and oiled. Wire rope is lubricated and carefully coiled or stored on reels.

About twenty men are employed around the shops and yards during the Winter months, these including machinists, carpenters, barn men and laborers. Three men are employed all the year round repairing wagons and wheelbarrows, sorting lumber and doing other odd jobs. The store yard is watched by Airedale and police dogs which have been trained to the work from puppies. Each dog has its beat which it traverses on runway chains; that is, a chain with a ring over a long trolley wire.

## Pennsylvania Automobile Tags

State Highway Commissioner Paul D. Wright has announced that he has already decided upon the color arrangement for automobile license tags for 1924. It is thought possible that the number of tags required next year will exceed 1,000,000, about 860,000 being necessary for the 1923 requirements. The 1923 Pennsylvania tag has gold numerals on a blue background and the 1924 tag will have blue numerals on a gold background, and it is stated that probably these two colors will be used henceforth on Pennsylvania tags, alternating the base and numeral colors each year. During the past sixteen years Pennsylvania has used for numerals white, black, red, brown and gold, and for backgrounds three shades of blue, vermillion, yellow, white, mahogany, olive green, black, orange, brown and cream.

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## Some Considerations in Selecting Excavating Equipment

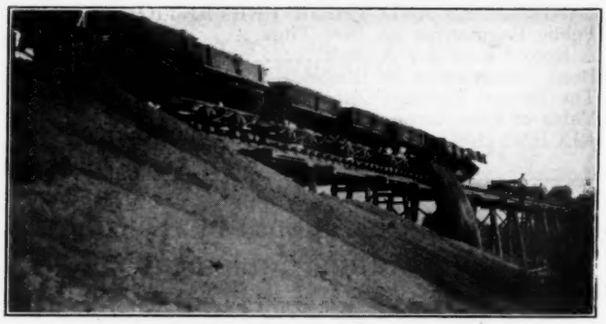
Occasionally we hear a contractor remark that this idea of labor-saving equipment is all bunk—that the machinery costs more than the labor saved. While it is undoubtedly true that in some cases the ultimate cost of mechanical equipment, including transporting to and from the job, maintenance, etc., does not warrant substituting it for hand-labor, it is generally worth inquiring into whether the contractor making this remark has not been unwise in the selection of his equipment.

Where there is more than one piece of equipment, the several pieces should be adjusted to each other in capacity and otherwise, and all should be adjusted to the job itself. For instance, a 3½-yard steam shovel should not be used with 1½-yard dump cars, nor, on the other hand, would a 1½-yard shovel be used with 20-yard cars. A steam shovel costs money every minute, whether it is actually earning it or not, and it is most economically used only when it is kept busy performing its function of delivering dirt to cars or carts; which necessitates having enough cars to keep it hustling continuously. This, of course, requires at least two trains of cars, one being filled while the other is delivering its load and returning, or a sufficient number of trucks or wagons. Whether more than two trains are necessary, and the size of train, is determined by the size of car and length of haul.

Consider again the locomotive. This should be kept working up to its safe and effective capacity by the size of train it carries and the grade to which the track is laid. It needs little more than a statement of the fact to make it evident that if either of these three—steam shovel, dump cars and locomotive—is out of proper proportion to the others, one or all must be failing to deliver the maximum return for their cost, and may even be operated at a loss.

Not only must the items of equipment be adjusted to each other, however, but also to the job. Where a heavy cut is being made or for other reason a large amount of earth will be handled over a fixed location of track, heavy standard-gauge track carrying large-capacity cars and powerful locomotives may be used. The moving of such track, however, involves much more delay and expense than the moving of light track. Consequently, where there is shallow grading over a considerable area, a 24-inch gauge track carrying 1½-yard or 2-yard cars can be moved much more easily and quickly with practically no delay in the work. Moreover, with light cars of this kind much lighter temporary trestles, bridges, etc., can be used, the track can be carried over softer ground, etc. These small cars of course mean that ¾-yard or 1-yard dippers must be used on the steam shovels, or the cars may even be filled by hand.

Where the excavating is very shallow, consisting



MAKING FILL ACROSS MINNESOTA RIVER BOTTOMS

only in moving the top soil over a considerable area, it probably would not pay to use cars at all, but horse-drawn carts, which can change their route with every trip, would be preferable, or scrapers if the haul is short.

In modern highway work almost all conditions of excavation are found. Years ago highway cuts and fills were usually confined to a few feet depth, but now 25 feet or more is by no means uncommon. An illustration of this is the construction of Lindale Avenue leading out of Minneapolis, built by A. Guthrie & Co. This contract called for grading and gravelling 12 miles of road, part of which crossed the flats of the Minnesota river which lay 75 feet below the bluffs on either side. Cuts were made in the bluffs and the excavated material used to fill across the bottom, 400,000 cubic yards being removed from the two excavations and the maximum depth of cut being 65 feet. Here a trestle was built across the river bottoms and the material dumped from the trestle. This was unusually heavy work and 4-yard dump cars were used in trains of 11 cars each, five of such trains being operated from one side and four trains from the other.

As to the advantages of light dump cars and light track as compared to dump wagons, J. F. McFarlin, superintendent for W. M. Keesecker of Youngstown, Ohio, gives his opinion as follows, referring to the 1½-yard dump car:

"They are as flexible as dump wagons. They will do anything a dump wagon will do and some things which a dump wagon can't do. The 20-pound track is easily shifted. If a car gets off the track onto soft fill, two men can put it on again. Three men take care of dumping two trains of six to eight cars each—on 5% grades—and maintain the track. Each car is loaded with fully two cubic yards. We put stones on those cars sometimes, so large that they cannot be dumped. It is a simple matter to take off the side doors and slide the stones off. It is abuse, I know, but the cars seem to stand it."

Contractors now have the choice of a wider variety of sizes, types and makes of scrapers, shovels, excavators, wagons, cars and other earth handling equipment than ever before, and can therefore make more profit than ever before if they select their equipment wisely for the work in hand; and can lose more if they make an unwise selection. The day of the pick-and-shovel-and-dump-cart contractor is over except for small jobs or exceptional circumstances, and they must be pretty small or exceptional at that.

## Paving in Nebraska

The president of a large firm of contractors in Nebraska has recently expressed the opinion that in that state the cost of paving this year will be about the same as last, although some of the paving materials may cost a little more and this may be reflected slightly in higher paving costs. He reported a greater demand for labor than a year ago. He estimated that the cost of paving now is approximately 25 per cent. less than it was five years ago. More paving is anticipated in the smaller cities of the state than in the larger ones.

## Highway Information in North Dakota

Reference was made some weeks ago to the value that the cause of good roads and the citizens of many of the States derive from the bulletins published by the State Highway Commissions, in most cases once a month. We have just received a bulletin of the North Dakota State Highway Commission containing the following foreword:

"The State Highway Commission has never felt that it had sufficient funds to regularly publish a bulletin such as most highway departments get out. For this reason the people of North Dakota have had very limited opportunity for becoming acquainted with the work of the department. The regular biennial report gotten out by the State Engineer being entirely too bulky and expensive to print for general distribution, it appears very proper at this time to get out a supplement to the regular report for distribution to all county commissioners, legislators and others interested in highways."

## Contractor vs. Sewer

In eliminating a grade crossing at Milwaukee, a contractor, in digging foundation for retaining walls in First avenue, ran into 10 feet of wet quicksand at the bottom of an 18-foot cut. To further complicate matters there was a heavy surcharge caused by the railroad embankment alongside, the top of the embankment being 50 feet above the bottom of the trench. Under this cut ran a 10-foot concrete sewer which the contractor used greatly to his advantage, but we are wondering what happened to the sewer.

Learning of the location of the sewer, the contractor punched several holes into the crown of it under the quicksand, which in a short time drained the water from the sand and enabled the contractor to complete the excavation of the foundation and build the retaining walls and abutments for which the trench was excavated without extra expense and delay.

Our informant does not state and perhaps no one took the pains to investigate the effect of this upon the sewer, but if the quicksand is like most of that with which the writer has come in contact, water was not the only thing that entered the sewer through the holes made by the contractor.

# Concrete Chimney Built in Winter

We have received from P. H. Knight, city engineer of Frankfort, Indiana, an interesting description of the construction for the municipal power plant of that city by the Weber Chimney Company of a reinforced concrete stack during weather when the temperature reached below freezing almost every day.

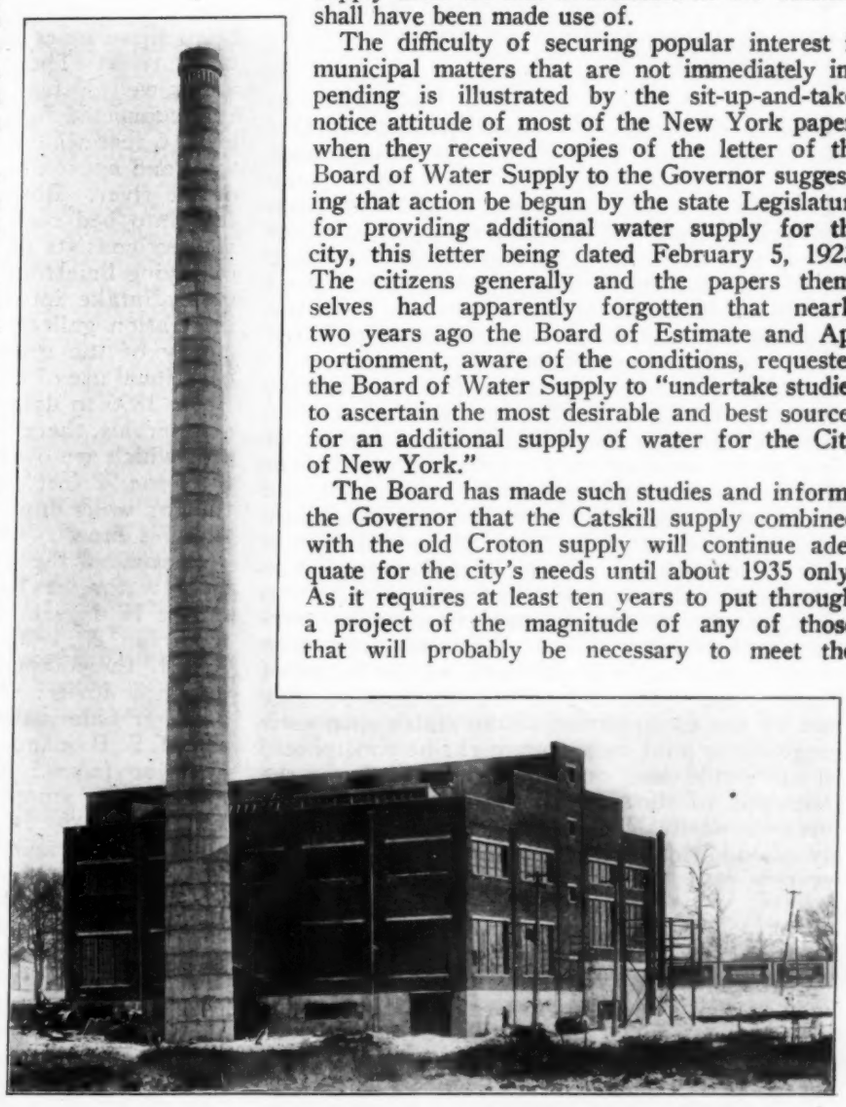
Freight embargoes and other causes prevented starting construction of this stack until last November and concreting was continued during that month and December and January, the final section being poured on January 30th.

The chimney rests on a concrete base 30 feet in diameter and extending 7 feet below the surface. The shaft rises 202 feet above the surface and has an inside diameter of 84 inches at the top and 9 feet 10⅝ inches at the base, with wall thicknesses varying from 5 inches at the top to 12¼ inches just above the base. For 63 feet above the base a 4-inch air space is left between the shaft proper and a 4-inch concrete lining.

The concrete was poured in forms of which two complete sets were used, each 4 feet 6 inches high. The concrete mixer and hoist were electrically driven. All concrete materials were heated by steam jets from an old traction engine, which also provided steam through a pipe to the air space between the stack and the lining above referred to. At night a coke fire was burned in a salamander inside the stack and during the coldest weather a tarpaulin was stretched over the top of the shaft.

Work on the shaft above the foundation began Nov. 30th, five days having been occupied in constructing the base. Owing to the days that were too stormy to work and the holidays between Christmas and New Year's, there were only 55 actual working days used for construction. The lowest temperature was 4 degrees below zero and on five days it did not reach above 14 degrees, while the highest temperature reached was 59 degrees. There were two days in January, when the wind probably reached forty miles an hour.

Mr. Knight states that "an especially smooth surface was obtained both outside and inside and, while a wash coat of equal parts of lime and cement was specified, this seems of debatable value as far as strength, durability or appearance is concerned."



CHIMNEY CONSTRUCTED DURING FREEZING WEATHER.

# Delaware River for New York Water Supply

Although the Catskill water supply for New York City has not reached the point in development where all of it is available, the Shandaken tunnel not having been holed-in until Feb. 13th of this year, and it will probably be three years more before the construction work in connection with the Catskill supply is completed, consideration is already being given to the problem of where the city is to obtain an additional supply after all that is available in the Catskills shall have been made use of.

The difficulty of securing popular interest in municipal matters that are not immediately impending is illustrated by the sit-up-and-take-notice attitude of most of the New York papers when they received copies of the letter of the Board of Water Supply to the Governor suggesting that action be begun by the state Legislature for providing additional water supply for the city, this letter being dated February 5, 1923. The citizens generally and the papers themselves had apparently forgotten that nearly two years ago the Board of Estimate and Apportionment, aware of the conditions, requested the Board of Water Supply to "undertake studies to ascertain the most desirable and best sources for an additional supply of water for the City of New York."

The Board has made such studies and informs the Governor that the Catskill supply combined with the old Croton supply will continue adequate for the city's needs until about 1935 only. As it requires at least ten years to put through a project of the magnitude of any of those that will probably be necessary to meet the

demand, a beginning of the legislative procedure should be made by the present Legislature, if possible.

Among the sources of supply considered has been the Delaware river. While this river rises in the State of New York, about 65 miles from its source it becomes the boundary between that state and Pennsylvania and continues as such a distance of 82 miles, beyond which, for a distance of about 100 miles, it marks the dividing line between New Jersey and Pennsylvania. The drainage area above Port Jervis, the southernmost point on the river between Pennsylvania and New York, is 3,435 miles, of which about 70 per cent. is entirely within the State of New York. Because of the joint rights between the two states it is impossible for either of them to develop the river alone; and, as a matter of fact, its resources have not been developed nor conserved, and it is suggested that a commission be appointed by New York State to confer with similar commissions representing New Jersey and Pennsylvania to negotiate and agree upon a treaty between these states and the Federal Government with a view to such joint conservation and development.

TRI-STATE CO-OPERATION

Among the benefits to be obtained by this joint development would be: (a) A large supply of hydro-electric power which would take the place of much energy now derived from high-priced coal; (b) supplies of water for municipal and domestic consumption of the large future populations in each of the three states; (c) the equalization of the river flow with the resulting reduction of flood damages and the benefits of a more uniform low season flow.

It may be remembered that a few months ago, as recorded in Public Works, Allen Hazen submitted a report to the authorities of the State of New Jersey making suggestions and recommendations for developing a water supply for the metropolitan district of New Jersey around New York and that around Philadelphia; and that in connection with the former he recommended as an ultimate development bringing water from the Delaware across the state to a large reservoir south of Morristown. While no suggestion of the kind is made in the letter of the Board of Water Supply above referred to, it is possible that by the co-operation of the states such as is suggested a joint reservoir might be constructed which would not only bring water from the Delaware to the metropolitan section of New Jersey opposite New York, but would also supply an additional amount for use in the latter city.

## Garbage Disposal in Flint, Michigan

Garbage collected by Flint, Michigan, is fed to hogs on a city-owned farm located about 15 miles from the city. The city has approximately 100,000 population and the cost of collecting for the year 1921 was $75,231. There was an increase of about 248,000 pounds of pork on the hog farm. The method has been entirely satisfactory.

# Chlorination at Delaware

**In spite of continuous use of chlorine at a high rate, an epidemic of enteritis occurred at Delaware, O., and the state health officials found the disinfection to be "not entirely satisfactory."**

The U. S. Bureau of Public Health has made public a report on an investigation made by the Engineering Division of the Ohio State Department of Health upon the water supply of the state of Delaware, Ohio, the especially interesting features of which are the finding of the failure of chlorination and the possible influence of hog cholera on the watershed above the intake upon the failure of chlorination and upon the epidemic of water-borne disease.

The works of the Delaware Water Company, which were placed in operation in 1889, are located three miles north of the city on the Olentangy river. The original source of supply was a dug well 30 feet in diameter and 28 feet deep and, connected to it, an infiltration gallery 4 feet high, 6 feet wide and 293 feet long and parallel with and approximately 100 feet from the bank of the river. Both of these extend about three feet into bed rock. The soil formation in the vicinity consists of glacial deposits 25 feet deep overlying limestone bed rock. There is an emergency intake into the river at the end of the infiltration gallery and as early as 1895 insufficiency of the ground water supply led to the occasional use of river water through this intake. From 1896 to date deep wells have been drilled at intervals, there being at present 25 such wells, 4 of which are over 225 feet deep, one about 150 feet, one 92 feet, and the remaining are shallow tubular wells down to rock. The 150-foot well supplies most of the water derived from wells.

Because of the insufficiency of the well supply, river water was taken through the emergency intake 15 days in 1918 and almost continuously from Jan. 28, 1920, up to the time of the report. In 1917 the company installed a chlorination disinfection device. In 1920 this was replaced with a larger chlorinator, a Wallace and Tiernan of the M. S. B. manually controlled type, capable of applying from 5 lbs. of chlorine per day up to any desired amount. A venturi meter was installed to assist in accurate proportioning of the chlorine dose, and suitable indicating and recording devices registered the amount of water being pumped and of chlorine being applied.

Four times in 1920 representatives of the State Health Department took samples of the water furnished, which was a combination of well and river water, and, although it was being treated by the disinfection process, uniformly poor results were obtained, showing the disinfection to be not entirely satisfactory. In November, 1921, samples collected indicated that the water still was not entirely satisfactory from a sanitary standpoint

in spite of continuous excessive chlorination, varying between 1 and 2 parts per million. The citizens of Delaware complained regarding the chlorine tastes throughout the year 1921, from which it is evident that the company had been attempting to disinfect the water sufficiently to make it safe. There were no interruptions in the chlorine treatment, but nevertheless numerous tests by the city's consulting analyst showed unsatisfactory results in the tap water during 1921. The Health Department, therefore, was forced to conclude that in this case disinfection of combined river and well water was a failure.

During October and November, 1921, an extensive outbreak of intestinal disease occurred in Delaware. The division of communicable diseases investigated 743 cases and reported 373 as enteritis, and the public water supply was decided to be the source after a careful epidemiological study.

Inspection of the watershed conditions above Delaware revealed the fact that three farms less than seven miles above the intake had experienced an epidemic of hog cholera between October 1 and December 13, which had resulted in the death of about 40 animals, and that proper disposition had not been made of some of these, so that it was probable that the river water received serious bacterial pollution resulting from this epidemic.

Above Delaware there are one city and thirteen towns, two of which have public sewerage systems. For nine years previous to the installation of chlorine disinfection devices in 1917, the average typhoid death rate was 32.1 per 100,000, while for the four years following the rate averaged 11.3. All of the typhoid cases in 1921 occurred coincident with the enteritis outbreak, but the typhoid cases were relatively mild and no deaths occurred.

No suggestions are contained in the report (which was written by F. H. Waring, principal assistant engineer of the Ohio State Department of Health) as to the reason why the chlorine treatment was unsuccessful in this particular case. It may, however, be partly accounted for by the statement made incidentally in the report that presence of turbidity was noted in all of the tap samples collected November 28, the only date during the epidemic when samples were collected by the State Department.

### OPINION OF NEW JERSEY HEALTH DEPARTMENT

In this connection it may be pertinent to quote the following from the annual report for 1921 of the New Jersey Department of Health:

> Chlorination as the only safeguard for surface supplies subject to pollution is regarded by the Department as a temporary improvement only, and it is its policy to encourage, and, under certain circumstances, demand the additional protection of prolonged storage or filtration. The reason for this attitude is self-evident. Chlorinators seem to be peculiarly liable to breakdowns in their present stage of development, and when this occurs, potentially dangerous water must be furnished the consumers without treatment of any kind.

# St. Louis Public Improvement Program

At a special election in February, St. Louis voters authorized an outlay of over $87,000,000 for public improvements to be spent on twenty projects. Twenty-one projects were voted upon but $1,000,000 for a National Guard armory failed to receive authorization.

Of the twenty items the largest is $12,000,000 for extensions to the waterworks plant, to be paid for out of the waterworks revenues. Next came $11,000,000 for the River DesPeres sanitation purposes; followed by $8,650,000 for opening and widening streets, $8,000,000 for city-wide electric lighting, another $8,000,000 for construction and reconstruction of sewers, $6,000,000 for a memorial plaza and building, $5,800,000 for street-paving and improvement, $5,000,000 for a municipal auditorium and community center, $4,500,000 for a hospital and other public institutions, $4,000,000 for a new courthouse and the balance for parks and playgrounds, fire department, grade crossings, public markets and other improvements.

Under the city's charter the department of the president of the Board of Public Service has charge of all engineering and architectural work, such as streets, sewers, public buildings, etc., but has assigned to the Department of Public Utilities all construction work incident to the waterworks. Consequently the Board of Public Service will have immediate charge of the spending of $45,000,000 of the amount authorized. The department has plans all completed for immediate inauguration of some of this work, but plans for others have not yet been started. For instance, expenditures from the appropriation for paving and improving streets will be made as the various thoroughfares are ready for paving. About $600,000 will probably be spent in the reconstruction of worn out streets which have become major thoroughfares but which do not require widening, but it is expected that at least five years will be required to complete the work under this item. A considerable part of the sewer work can be started very soon, preliminary plans having been completed and most of the right-of-way having been secured for the North Baden sewer estimated to cost $840,000, for which final plans can be ready by the time the necessary ordinances are passed. The same is true of relief sewers in two districts, the combined cost of which is estimated at $1,035,000. One hundred and fifty thousand dollars is to be spent in constructing street inlets for draining sections where flooding now occurs because of insufficient inlet capacity.

It is intended to make an early start on the River DesPeres improvement, preliminary plans for which were completed sometime ago. As to the municipal auditorium, the site for this has not yet been selected but Mayor Kinsey will at once organize a conference of citizens to outline the plans for this community center. Before ob-

taining plans for the memorial building the local chapter of the American Institute of Architects will be consulted as to the best means of obtaining architectural reports of the highest order.

## Buffalo's Municipal Gas Well

The city of Buffalo has driven a gas well on the city hospital property, which was "brought in" on January 29 and is giving a flow of between one-half million and a million cubic feet daily. The city has had to take special precautions to control the well, the pressure in which is 1,025 lbs per square inch. In order to do this 3,420 feet of 3-inch pipe of high tensile strength weighing about 15 tons has been placed in the well, which is anchored to the 6-inch casing which weighs about 30 tons and to the 8 and 10-inch outer casings weighing 10 to 15 tons more, giving a total weight of 50 tons. High pressure valves and fittings are used.

It is proposed to use the gas for heating, cooking, laboratory and other purposes in the municipal hospital, thus saving a considerable sum for fuel, the hospital commission having asked for an appropriation of $30,000 for this year, much of which can probably be saved by the use of the gas.

# Concrete Mixers and Mixing*

By F. S. Besson†

**Capacity and rating of mixers and actual output. Selecting the size suitable for a given mix and job.**

*Speed of Drum.* The Joint Committee recommended a peripheral speed of about 200 feet per minute. This means that a drum of large diameter would be permitted to revolve slower than one of smaller diameter. Generally the drum speed has been specified in the past in terms of revolutions per minute. With practically all makes of batch mixers there is little effect on the strength of concrete within the limits of 10 to 30 R. P. M. If the drum is not overloaded, mixers as furnished by the manufacturers will give satisfactory drum speed—the main thing is to see that the charge is mixed for at least a minute.

### MIXER RATING

According to the Concrete Mixer Association, the quantity of mixed concrete a mixer can deliver is used as a rating basis, and mixer numbers indicate the capacities in cubic feet of mixed concrete per batch. The amount of concrete obtained from a given quantity of unmixed material depends greatly upon the character of the aggregate, also upon the amount of water used. As a rough rule of thumb, the capacity in unmixed material per batch, for each size of mixer, in cubic feet, may be assumed to be 10/7 times the mixer number. (In place of 10-7 the ratio 3-2 is often assumed). Usually it is considered for rating purposes that mixers are able to turn out 40 batches per hour. Accordingly, since the ratio 10/7 is approximately the same as

$$\frac{40 \text{ (batches per hour)}}{27 \text{ (cu. ft. in 1 cu. yd.)}}$$

the figures representing the batch capacities in cu. ft. of unmixed material may also be taken as representing the rated output per hour of mixed concrete in cubic yards. It must be realized that "rated output" is an arbitrary figure chosen for classification purposes. It too often differs greatly from "actual output" which latter figure depends upon the time of mixing and upon the equipment available for getting materials into the mixer and concrete away; and further upon the organizing ability of the man in charge and his efficiency in handling his equipment.

Mixer ratings are shown in the accompanying table, also bag capacities per batch for four commonly used concrete proportions.

**Arbitrary Rating Table for Mixers**

| Size of Mixer | Capacity Mixed Concrete per Batch | Capacity Unmixed Material | Rated Output at 40 Batches per Hour | Cement Per Batch | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1—3—6 | 1—2½—5 | 1—2—4 | 1—2—3 |
| No. | Cu. Ft. | Cu. Ft. | Cu. Yds. | Bags | Bags | Bags | Bags |
| 3 | 3 | 4.3 | 4.3 | .43 | .50 | .61 | .72 |
| 4 | 4 | 5.7 | 5.7 | .57 | .67 | .81 | .95 |
| 7 | 7 | 10.0 | 10.0 | 1.0 | 1.18 | 1.43 | 1.67 |
| 10 | 10 | 14.4 | 14.4 | 1.44 | 1.68 | 2.05 | 2.40 |
| 14 | 14 | 20.0 | 0.0 | 2.0 | 2.35 | 2.85 | 3.35 |
| 21 | 21 | 30.0 | 30.0 | 3.0 | 3.55 | 4.30 | 5.00 |
| 28 | 28 | 40.0 | 40.0 | 4.0 | 4.70 | 5.70 | 6.65 |
| 56 | 56 | 80.0 | 80.0 | 8.0 | 9.40 | 11.40 | 13.30 |
| 112 | 112 | 160.0 | 160.0 | 16.0 | 18.80 | 22.85 | 26.65 |

It is seen from the table that the factor 7 enters largely into the numbering of mixer sizes, and that for a 1-3-6 mixture, the sum of the ingredients being 10, the cement per batch for a No. 7 mixer equals 1 bag, for a No. 14 it equals 2 bags, and so on to 16 bags for a No. 112. This appears to explain to some extent the choice of the ratio 7-10 as a factor for changing unmixed materials to mixed concrete.

The fractional figures in the last four columns of the table do not signify that a contractor would split a bag of cement; in fact, most specifications prohibit such a procedure, though if bulk cement were used exact quantities of cement might be used in order to obtain full mixer capacity. The data in these four columns show that the scheme often followed of basing mixer capacities on rich concrete and calling the No. 10 mixer a 2-bag machine, the No. 14 a 3-bag machine, and so on, is much too general a characterization. Also these data show whether or not there is a tendency to overloading the mixer when a full bag mix is used as an approximation to the capacity of the mixer. Most manufacturers' ratings are conservative and allow for approximately 10 per cent. excess capacity on all

*Continued from page 48.
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sizes, though there is some difference in mixers, rated of equal size, but made by different manufacturers. If a mixer labors under its charge, turns over slowly and gives poorly mixed concrete, it is undoubtedly overloaded. One objectionable feature connected with mixer overloading is that a tendency is created to use an excessive amount of water in order to give the poorly mixed concrete the desired consistency.

*Actual Output of Mixers.* Both engineers and contractors seldom realize how little time is consumed on actual work under contract, and how much avoidable delays increase the cost of construction operations. This is particularly true in the case of concrete paving. There are the usual delays which may be charged to "Administration," including, for example, time consumed in contractual formalities, shipping equipment, organizing forces, and other preliminary work carried out after the award of the contract, but before work is actually commenced. Bad weather is always the cause of many days' lost time; the only lost time, though, which is fully excusable. Moving from job to job consumes much time. Lack of materials frequently causes considerable delay which can generally be avoided by using foresight in laying out proper storage. Lack of water supply is a frequent cause of delay, often simply because water pipe too small in diameter has been purchased. In cities generally the source of supply is ample; sometimes pumps have to be installed, in which case care should be taken to have them large enough. A delay that is always avoidable is that where failure to prepare the sub-grade in time prevents continuous operation of the mixer. Waiting for the completion of accessory and incidental work, as curb setting, the installing of gas, water and other services, etc., invariably uses up a great deal of time and this can be remedied only through the closest possible coordination.

In Illinois during 1921, of 102 contractors' paving mixers, one operated 129 days, two 121 days, two 105 days, and all the rest less than 100 days. In Iowa, during the same year, mixers used on thirty-one different contracts spread throughout the state averaged but 74 operating days and only 55 full days were worked, calling every day a full day if the lost time was less than three-quarters of an hour. Of 35 per cent. lost time, only 1.09 per cent. was lost because of machinery breakdowns.

## Contractors Association Sues Editor

Contractors of Virginia not long ago organized as the Virginia Highway Contractors' Association, which was accused by the Winchester Star and some other papers of having as its object the obtaining of higher prices for highway work in the state. Indignantly protesting against this accusation, the managing director of the association, Robert W. Woolley, threatened to sue the owner of the Star in the sum of $100,000 for libel. Mr. Woolley states that the organization is opposed to monopoly and that he will personally combat any attempt at monopolistic practices by members of the association.

The paper sued also claims that the association is urging the people to vote in favor of the $50,000,000 bond issue, but Mr. Woolley states that the association has taken no stand in the matter but that, if anything, the bond issue would naturally be opposed by the contractors. The reason for this is that a large bond issue means that the highway construction will be let in large contracts which will be completed within a very few years and which will attract to the state large contractors from outside; while if the work is done by smaller increments spread over a longer period of time, it will not be so attractive to outside contractors and Virginia contractors can probably secure all the work and keep busy at it for many years to come.

# Cleveland's Grease and Tankage Prices

The city of Cleveland, Ohio, in December awarded contracts for the purchase of grease and tankage produced at the municipal garbage reduction plant during the first six months of the year 1923. The tankage to be sold was estimated to be approximately 700 tons a month, the city retaining the right, however, of holding out not to exceed 50 tons per month should it desire. The price paid was to be f. o. b. Willow, Ohio, and would be on the basis of analyses, the bidder stating how much he would give for each unit of ammonia, of bone phosphate of lime, and of potash; the tankage being shipped in bulk in carload lots. Analyses are made by the city chemist as a basis of payment, but should the buyer's chemist arrive at results different from these by not exceeding 1% in bone phosphate, 0.2% in ammonia and 0.1% in potash, the analyses of the buyer and seller are averaged as a basis of payment. If two or more of the respective figures of the analyses of buyer and seller exceed these limits, but in such a manner as to leave the final monetary value of the shipment practically the same, the figures of one party are to be accepted for one ingredient and the figures of the other party for the other ingredient. If, however, the analyses vary so widely as to render settlement impossible, a duplicate sample is to be submitted to a third analyst of national repute agreeable to both parties and his results shall form the basis of payment; the cost of this analysis being borne by the party whose analysis differed most widely from it.

The ammonia is to be determined by the Kjeldahl-Gunning Arnold method as given in the U. S. Dept. of Agriculture circular No. 108. All other determinations in the tankage analysis are to be made by the official fertilizer methods of the Association of Official Agricultural Chemists. Payments are to be made within ten days after receiving the bill for the same, regardless of any differences in analysis, but these are to be adjusted at once in the way described above.

Each car of tankage is to be weighed on the city's scales at the garbage plant, these scales being certified to and sealed by the City Sealer of Cleveland, or on the scales of the Baltimore & Ohio Railroad if the city's scales are out of commission.

Only one bid was received for tankage, and the contract was awarded to that bidder, The Packing House By-Products Company, the prices offered being $1.25 for each unit of ammonia, 10c for each unit of bone phosphate of lime, and 70c for each unit of potash. This is estimated to give an average of about $6 per ton.

Six bids were received for grease as follows: The M. Werk Company, $4.21½ per cwt.; the Rub-No-More Company, $4.41; The Packing House By-Products Company, $5.03; The Wilson Martin Company, $5.06; C. E. Woodworth, $5.75; Charles L. Gohr, Jr., $5.87½. This contract was awarded to the highest bidder. This price for grease is about 40% of that received in 1918, but is higher than that received either in 1914 or in 1915. In the case of the tankage, the price received is about 32% of that received in 1918 and about 60% of that in 1919 and practically the same as that received in 1913.

The contract for the purchase of the grease provides that it shall be sold on the usual basis of 97% available fats, the amount of dirt, moisture and foreign substance or unsaponifiable matter being determined by the city chemist. It is estimated that the grease will amount to about 500,000 pounds per month. Should the buyer's chemist differ from the city chemist in his analysis, "he shall have the privilege of testing and checking the analysis at the city laboratory, and if such test shows an error in the analysis by the city chemist, then the bill shall be corrected to conform to the result of the test and all the expense of making such test, including the traveling expenses of the buyer's chemist, shall be assumed by the seller." Unsaponifiable matter is to be determined by what is known as the Morawski & Demski method. The hydro-carbon is to be dried in a dry oven at 105° centigrade for at least five hours. Extraction is to be carried on three times, using first 100 c. c., then 75 c. c., and then 50 c. c., for the solvent. The petroleum ether used in this determination shall be clear distillate testing 86° Beaume, leaving no residue when evaporated on the steam bath.

# Abuse of Separate Sewers and Storm Drains*

**The ways in which such abuse is practiced, the causes therefor, and remedies suggested. Sewer misuse "little short of an engineering calamity."**

The object of this paper is to present in a forcible manner the present status of many of the systems of separate sewers and storm drains in this country, to sound a note of warning against a continuance of abuses now more or less generally prevalent, and to offer some suggestions which insofar as they may prove practicable of adoption, may restrain misuse and thus tend to avert a general condition which appears to the author in some specific cases to be little short of an engineering calamity. The membership of this Society perhaps has a better opportunity than that of any other to render helpful service in this field.

**Definitions.** A committee of the Sanitary Engineering Section of the American Public Health Association has presented the following pertinent definitions:

"A separate sewer is a sewer intended to receive domestic sewage and industrial wastes without the admixtures of surface or storm water."

"A storm drain is a conduit for carrying off surface water and storm water."

"A combined sewer is a sewer intended to receive domestic sewage, industrial wastes and surface and storm water."

### ABUSE OF SEPARATE SEWERS AND STORM DRAINS

In a paper entitled "Prevention of Misuse of Sewers,"† Mr. W. H. Dittoe has stated clearly the manner in which storm drains and sewers are being misused, as follows:

> Sewers are designed for definite purposes and if used for other purposes are being misused. Storm drains are misused if receiving sewage, industrial wastes or other wastes of objectionable character. Combined sewers are properly used when removing all classes of liquid wastes, but are misused if receiving industrial wastes affecting sewerage systems or processes of sewage treatment.
>
> Sanitary sewers, as the name implies, are for sanitary purposes only, and are misused if they receive drainage from the surface and roofs, subsoil drainage such as may be admitted by building foundation drains and through open or leaky joints, and industrial wastes of a character to affect the sewage or treatment processes.

Combined systems with intercepting sewers and storm overflows permit the discharge of sew-

* A paper, somewhat condensed, before the American Society for Municipal Improvements, by Harrison P. Eddy, of the firm of Metcalf and Eddy, consulting engineers.

† Public Works, January 7, 1922.

age mingled with storm water through such overflows into water courses. In general the total quantity of sewage (not including storm water) thus discharged probably aggregates from 2 to 5 per cent. of the total quantity produced during the year. One of the important objects of separate sewers is to prevent this periodic discharge of sewage into small streams and bodies of water.

In many cases, however, sewage is discharged into storm drains through incorrect house connections, and even through common sewers which have been connected with storm drains. This in greater or less measure, as the case may be, defeats one important objection of the adoption of the separate system in preference to the combined system. Such discharge is not confined to periods of storm, but is continuous and may readily constitute a greater source of pollution and offense than sewage discharged from combined sewer overflows in times of storm. Only from 2 to 5 per cent. of the building connections wrongly made would be required to provide a quantity of sewage equal in the aggregate to that discharged from combined sewer storm overflows. In many cases the continuous discharge of sewage from even a smaller proportion of the houses would constitute a greater source of annoyance on account of its discharge in dry weather and at times of low stream flow.

Great annoyance and damage have resulted from the discharge of storm and ground water into separate sewers. This occurs through the connection with the sewers of roofs, street inlets and foundation and cellar drains, and in some cases even small brooks. Sewers are sometimes so poorly built that they receive large quantities of ground water that should be cared for by natural channels or storm drains. Even where the sewers are most carefully built to exclude extraneous water, the house connections are often so improperly made that large quantities of ground water find access to the sewers, thus nullifying the effort and money expended in securing excellence of workmanship in their construction.

The results of such abuses have been serious in many places. In others, however, the ill effects have not yet been so important, because the improper connection of roofs and inlets and the faulty workmanship upon sewers and house connections go on gradually and considerable time may be required for their cumulative effect to become such as to cause damage and demand public attention. The effect of such abuses is destined to increase greatly as time goes on.

ILLUSTRATION OF SURCHARGED SEWERS

In one case a city has been compelled to approximately double the size of its sewage treatment plant, solely because of the admission of water to separate sewers. The sources of this water were many, including defective house connections, street inlets, perforated manhole lids particularly within street car tracks, and abandoned house connections which were not sealed when buildings were burned or removed.

One of the most important sources in this case appears to have been wet cellars from which water was drained to the separate sewers through the cleanouts in cast iron soil pipes laid below cellar floors. There are many buildings located on side hills in some of which there is ledge. During and after rains, large quantities of ground water enter the cellars, and the owners, or tenants, remove the caps from cleanouts and allow the water to drain out. In some cases the cleanout caps have been left out continuously.

So large a quantity of water is admitted to the separate sewers in this city that the trunk sewer some three miles long is often overtaxed, and occasionally the sewage has escaped through the manhole covers into the streets and run over the ground into a neighboring water supply reservoir, which, finally, was protected by sand filters built to receive the sewage before it could reach the reservoir. The trunk sewer should be augmented now although it is of ample size to serve the city adequately for many years to come were it not for this abuse of the separate sewers.

Considerable money has been expended in an effort to remedy the defects in this system. Street inlets have been disconnected, perforations in manhole covers have been closed by means of rivets, abandoned house connections have been sealed, and one sewer has been rebuilt, but the net result of this work has been small. It is practically impossible to correct many of the defects. Fortunately the growth of the city has been comparatively slow and the separate sewers are serving a useful purpose notwithstanding their defects. However, from the point of view of the service which might be rendered by the system under reasonably favorable conditions, it has failed in large measure.

Probably few systems of separate sewers have been so designed that they can receive the roof water from more than about 1% of the tributary houses without being surcharged at times of intense downpours after the districts they are to serve shall have been built up to the extent contemplated in the design. If there are also other source of admission of water, such as street inlets and perforated manhole lids, the number will be correspondingly less.

In some places the sewers have been surcharged to such an extent that sewage has flowed back through house connections into the cellars, while in others it has escaped through manhole covers into the streets. Just how far such conditions can be tolerated without justifying the statement that the sewer system is a failure, is a debatable question.

Such abuses may ultimately require enlarged treatment and pumping plants, increased operating expenses and augmenting the sewer systems, first by relieving the main sewers, and later the submain sewers and perhaps even the lateral sewers.

It is believed that these are not isolated cases and that these conditions are rather general. On the other hand, some systems have been satisfactory. This is probably particularly true in very

small slow-growing communities and where the local administration has been good.

### CAUSES OF MISUSE OF SEPARATE SEWERS AND STORM DRAINS

The principal causes of the misuse of separate sewers and storm drains may be grouped in six classes as follows:

*First,* ignorance of the purpose and objects of the sewers and drains is an important cause of their misuse. This ignorance is often due to lack of proper instructions from those designing the systems. It is due also in many cases to frequent changes in administration, as a result of which officials many times are entirely ignorant of the intent and plan of the systems. Sometimes many, or all, of the records and drawings are lost or have never been properly filed for available use in the municipal offices. In such cases whatever knowledge there may be is often lodged in the minds of a few tradesmen such as building contractors and plumbers. In some places this knowledge is a portion of their stock in trade. They make the connections for the building owners, sometimes in the cheapest possible manner, regardless of known proprieties, and in others incorrectly, through ignorance.

*Second,* misuse has arisen also from indifference of municipal officials. In one instance coming under the author's observation the city officials having jurisdiction over the making of house connections and the operation and maintenance of the sewer and drainage systems, apparently made no effective effort to secure correct connections, notwithstanding that they were formally notified of the intended use of the sewers and drains, of the fact that connections were being improperly made, and that a continuance of the existing policy would thwart the plan adopted for maintaining the natural water courses in a clean, presentable condition and would result in the surcharging of the separate sewers and in injury to property due to flooding, for which the city might be legally liable in damages. Such indifference may arise from many causes, some of which naturally fall under the other groups herein discussed. Probably the most important is the lack of moral stamina to require the making of proper house connections by building owners, notwithstanding their protests urged as a matter of personal privilege.

*Third,* lack of authority to enforce suitable regulations has been a cause of misuse in some instances. Where there is no state law or municipal ordinance the city official having jurisdiction must assume the authority, which requires a strong personality. An official assuming such authority will often find himself without the support of superior officials.

*Fourth,* favoritism or "pull" has undoubtedly played an important part in permitting the making of incorrect house connections. While the relative number of cases which can be so classified may be small, their existence tends to undermine the authority conveyed by law or assumed by the official in charge. If there is precedent for disregarding regulations, many requests for such privilege are likely to follow. It is cheaper to lay one connection than two. A building may be provided with a sewer connection, and later the discharge of roof water on to the ground may become a cause of annoyance. It is obviously a simple matter to discharge this roof water into the soil pipe connected with a separate sewer, and the owner is likely to feel that it is a great hardship to be obliged to lay a new connection all the way from his roof water pipe to the public drain. Additions to buildings frequently require the disposal of surface water. These additions may be very small, such, for example, as a bay window or piazza, and the official who has the moral stamina to require the owner to lay a drain to the public sewer for the purpose of serving such a small addition, is likely to be severely criticized by the owner.

*Fifth,* surreptitious connections undoubtedly have been an important cause of the misuse of sewers and drains. In many cases, particularly in times of high cost of construction work, building owners undertake to make certain improvements or repairs directly, or through the employment of journeyman mechanics. Often, too, it happens that such mechanics are the owners of buildings, and it is natural for them to do their own work where practicable. Over such work the city officials have no control, as application for permits is not made. Building owners are often annoyed by surface or ground water where no drain is available for its reception. Explanation and argument on the part of the city official usually afford the owner little satisfaction. This is particularly true in cases where he has paid the same sewer assessment as his neighbor in front of whose property the storm water drain was constructed. The owner who lacks the drainage facilities is certain to feel that he has been inequitably treated, and there is no doubt that in many cases he has attempted to square accounts by making the needed connection with whatever pipe was available and without the knowledge of th officials. The discharge of cellar drainage through the soil pipe cleanouts has already been discussed.

*Sixth,* in relatively few instances misuse has undoubtedly been due to incorrect connections made through error. In some cases the pipes between the building and the public sewer are laid in advance of the installation of plumbing. Later the plumber may readily mistake the sewer connection for the drain connection and transpose the tributary pipes within the building. In other cases the plumbing is first to be installed and the drain-layer may erroneously connect the soil pipe with the drain and the roof water system with the sewer. Probably such errors constitute the least serious of the causes of improper connections.

*(To be continued)*

## Notes on Bluefield's Sewer Report

A report on extension and improvement of the sewerage system of Bluefield, West Virginia, has recently been submitted to the city authorities by Morris Knowles, Inc., which contains a few paragraphs that are of general interest.

The first of these deals with the comparative advantages of the separate and combined systems as determined under Bluefield conditions. The engineers recommend the separate system for the following reasons:

1. A separate system avoids heavy rock excavation incident to placing large storm water conduits sufficiently below cellar floors to avoid flooding of cellars.

2. The separate system permits improving of sanitary conditions at minimum expense. This applies particularly to areas having good natural drainage.

3. The separate system utilizes, to the greatest possible extent, the existing sewer construction.

4. The separate system involves minimum expenditures for future construction and operation of sewage treatment plants.

At present there are both combined and sanitary sewers in the city. The latter total about thirty miles varying in size from 6 inches to 15 inches, 6-inch pipe having been used extensively. There are only about 175 manholes in the thirty miles, or less than 6 to the mile. This "makes it impossible to obtain definite information regarding detailed location and exact grades." These sewers appear to have been operating satisfactorily and it is proposed to retain them to a large extent, but for future construction 8-inch pipe is recommended as the minimum size "for the reason that an 8-inch pipe is much less liable to clogging than a 6-inch pipe and involves only a moderate increase in cost above that of the smaller size mentioned."

In providing for storm water, attention is called to the objections found practically everywhere as well as in Bluefield to open streams running through the city, which are used as dumping places for miscellaneous rubbish and frequently become choked during times of spring floods. It is therefore proposed to substitute large enclosed concrete conduits for the present open channels.

"To avoid undue amounts of rock excavation, the larger drains have been designed as wide, shallow culverts with inside heights varying from 3 to 4½ feet. The top of these culverts is maintained at a distance of approximately 1½ feet below the gutter grades of adjoining streets in order to afford adequate surface drainage." The lots along considerable lengths of the sewers are below the sewer grade, but the deepening of the drains to remove storm water from these low-lying areas is considered impracticable on account of the excessive rock excavation involved. Instead, it is suggested that the low areas be filled up as fast as practicable.

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## City Furnishes Garbage Cans

The city of Bucyrus, Ohio, on receiving a deposit of $2.00 from each householder, will furnish garbage cans for his use and replace them when they become unfit for further service.

# Cleaning Drainage Channels with Dragline Excavator

The Rio Grande project of the U. S. Reclamation Service embraces about 150,000 acres, the object of the project being to drain the area, portions of which had become so water-logged as to be useless for any purpose. Construction of open drains was begun in 1917 and has benefited over 100,000 acres, which area is now suitable for cultivation. The total project includes 350 miles of drainage canals, and it is expected that they will be completed by October of next year.

In general, the drains were carried to a depth of 10 feet with side slopes of 1½ : 1 and a bottom width of 12 feet. A small amount of the excavated material was thrown upon one side to be levelled off for a roadway, while the balance was thrown into a spoil bank on the opposite side.

Soon after the completion of the drains, the banks began washing and sliding and filling up the bottom of the channel. This was accompanied by a heavy growth of tules in the bottom of the canal. In some cases canals three years old were found filled from 2 feet to 4 feet above the original bottom and with the entire bottom covered with tules which filled the channel and retarded the flow, this checking of velocity resulting in further deposits of sediment. The weeds have been cut from time to time, but this is an expense and of very temporary benefit.

Not long ago it was learned that watercress killed off tules and experiments are now being made to determine whether it is practicable to plant watercress in the drainage channels for this purpose.

In 1922 the accumulation of silt had so raised the grade in the Mesa drain in El Paso Valley that cutting the weeds would no longer suffice, and it was decided that the channel must be excavated to its original depth. This work was done by the use of a Pawling & Harnischfeger Excavator with a 37-foot boom and using a ½-yard bucket. With this machine, which travelled along one bank of the drain, the waterway was lowered to the original depth, but with a width of 6 or 7 feet instead of the original 12 feet, one object of this being to minimize further settling of the banks. The machine, using this small bucket and a shortened tripline, was able to remove the sediment from the channel without removing the growth on the slope and on the bench formed by the sluffing-off of the slope, thus leaving this growth as a protection against further sluffing, care being taken not to drag the bucket against the old bank. By taking pains a neat, uniform slope of bank was obtained and a bottom width of 6 to 8 feet, carried very closely to the original grade. By lowering the channel from 2 to 4 feet, the water surface in the drain was lowered from 1½ to 2½ feet.

Nine and a half miles of drain were cleaned in this way at a total cost of $3,149, or about $330 a mile; 40,875 cubic yards of material being removed at a unit cost of 8c. The average progress per day was 600 feet. In connection with this work the excavator made its own road ahead of it by levelling off and adding to the small spoil bank on this side, and also repaired breaks in the side of the drain caused by the wash of irrigation water flowing into it from the adjoining fields.

A comparison was made of cleaning drains working up grade and down grade, and it was learned that the down grade was the most successful. When digging up grade, much of the material was washed downstream and deposited there, raising the grade of the drain below which had been already lowered. It was even necessary in several instances, when the machine stopped operating for repairs, to place a sheet-pile cutoff across the drain to prevent the material above from washing down into the channel. It was at first thought that when digging down grade the bottom material would run back between shifts, but this did not occur, even when digging was interrupted for an entire day.

## Cost of Water Main Laying in Detroit

The annual report of the Board of Water Commissioners for the fiscal year 1921-22 gives unit costs for laying watermains of different sizes, to a total amount of 145 miles. The department uses labor-saving appliances to a considerable extent, but the details of the several jobs are not given in the summary.

The various jobs are grouped according to the size of pipes laid. The largest single item is 6-inch pipe, of which 202,167 feet were laid. The cost per foot for this pipe was as follows: For material, $1.33; cartage, 7c.; labor, 86c.; machine, 6c.; overhead, 31c.; a total of $2.63.

That the figures given are not of great value unless explained in considerable detail is indicated by an inspection of them. For instance, the average cost per foot of carting 12-inch steel pipe is given as 14c., while carting 16-inch steel pipe averaged 9c. Carting 42-inch cast-iron pipe averaged $4.41 per foot, while carting 48-inch averaged only $1.03. The labor item for 3-inch pipe is given as $4.40 a foot, for 6-inch pipe 86c., for 12-inch pipe $3.64, 24-inch $3.92, 30-inch $4.74, 36-inch $6.19. These last are all cast-iron pipe and are fairly proportional to the size. Comparing the cost of cast-iron and steel, we find the labor for 12-inch case-iron given as $2.48 and for steel as $1.43; for 16-inch cast-iron $3.64 and for 16-inch steel $2.47; for 24-inch cast-iron $3.92 and for 24-inch steel $2.99.

Where the quantities are considerable, the variation in cost of material should be more closely proportional to size and material than most other figures. We find 12-inch cast-iron pipe costing $3.31 per foot and 12-inch steel $2.89 (cast-iron presumably including the lead for joints as well as the pipe itself); 16-inch cast-iron $6.54 and 16-inch steel $4.12; 24-inche cast-iron $8.84 and 24-inch steel $6.34.

## Snowless Roads in Wyoming

The December issue of the Wyoming State Highway Department's *"News Letter"* gives on its editorial page the information that "Heavy snow, unaccompanied with wind at the time of falling or shortly thereafter, is so unusual for Wyoming that it is scarcely worth while to reckon with it, so that it is doubtful if we will ever be obliged to consider an extensive program of snow removal. Fortunately the wind accomplishes this for us, provided we give it a chance." To know that practically every snowstorm is going to be a blizzard may not be an unmixed blessing for a country, but at least it seems to have its compensations, judging from this editorial statement. Apparently in that country snow plows are unnecessary if only highway cuts be avoided.

However, the highway engineers must take advantage of this local peculiarity of snowstorms. Says this editorial: "The worst conditions exist . . . on some of the projects which were constructed before Wyoming came to find out that the usual custom of balancing cuts and fills must be disregarded and highways be graded up above the ground level in all cases to allow snow to blow off, and thus clear the road. In rough country this, of course, cannot always be done; but, by following the general policy and making proper use of snow fences where needed, the Federal Aid road can be made so nearly snowproof that, with but little work, traffic can be kept going at all times."

## Snow Removal in Rhode Island

The State Board of Public Roads of Rhode Island has kept 366 miles of state highways open after snowstorms at a cost this winter estimated at the end of February to be approximately $22,000. Forty-eight motor trucks and three tractors are used, equipped for snow removal and operated by crews of three men each—a driver, snow-plow operator and spare man to assist in forcing drifts.

Not all the equipment starts out in every storm. A certain number leave the stations when the snow is 2 inches deep. If there are indications that the storm is to be too severe for this limited number to keep the roads open, a second installment is added, thus enabling each to shorten the length of its beat. The third installment consists of the tractors, which do not go out unless conditions are extraordinarily bad and involve extremely heavy snow and serious drifting. At the outset efforts are made to maintain vehicular traffic by clearing a roadway 18 to 25 feet wide. On the day following the storm the force pushes the snow back further to make room for the next snowfall. About ½-inch of packed snow remains, but the first thaw quickly melts this and leaves a clean pavement.

In the streets of Hartford, Connecticut, the city has used snowplows on 5-ton motor trucks to clear residential streets, and steam shovels with caterpillar tread to load motor trucks at a less cost per cubic yard than by doing the same work by hand labor.

# Garbage Collection Statistics

**Information from four hundred cities telling method of collection, cost, number of collections per week, point from which garbage pail is taken by collectors, and whether the collection service is considered satisfactory by the municipal official who furnished the information. The last of several tables on garbage disposal, the first two of which were published in the December issue.**

## GARBAGE COLLECTION

NOTE: The following arbitrary meanings have been assigned to terms in this table: Municipal—by men paid by the city by the day or month. Contract—performed by private party or parties, who are paid by the city. Private—performed by private party or parties, who are paid by the householder, but at a rate determined by contract with the city. Individual—performed by the householder or by anyone with whom he may make arrangements, the city taking no part, unless to require that collectors take out licenses.

| City | By What Method | Cost of Collection | | | Number of Collections Per Week In | | Receptacles Collected From | Satisfactory? Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Paid By | Per Year Amount | Per | Summer | Winter | | |
| **Alabama:** | | | | | | | | |
| Fairfield | Municipal | City | $3.1488 | Family | 6 & 2 | 6 & 2 | ..... | Very satisfactory |
| Mobile | Municipal | ..... | ..... | ..... | 6 | 6 | Curb | Yes |
| Selma | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Talladega | Contract | City | 1,560.00 | ..... | 1 | 1 | Curb or back door | Backdoor coll. too exp. |
| **Arizona:** | | | | | | | | |
| Clifton | Municipal | ..... | ..... | ..... | 6 & 2 | 6 & 2 | Curb or back door | Satisfactory |
| Miami | Municipal | City | 7,000.00 | ..... | 7 | 7 | Curb | Satisfactory |
| Tucson | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| **Arkansas:** | | | | | | | | |
| Helena | Private | Tenants | 26.00 | Residence | 6 & 3 | 6 & 3 | Curb and alley | Satisfactory |
| **California:** | | | | | | | | |
| Alameda | Private | Tenants | 6.00 | Residence | 1 | 1 | ..... | ..... |
| Glendale | Municipal | Tenants | 4.00 | Residence | .. | .. | ..... | ..... |
| Long Beach | Municipal | City | 4.50 | Ton | .. | .. | ..... | ..... |
| Marysville | Private | Tenants | 9.00 | Residence | 3 | 3 | Back door | Satisfactory |
| Monrovia | Contract | City | 840.00 | ..... | 2 | 2 | Curb or alley | Satisfactory |
| Napa | Private | Tenant | 6.00 | Residence | 1 | 1 | ..... | Charges too high |
| Oakland | Private | Tenant | 6.00 | Residence | 1 | 1 | ..... | Satisfactory |
| Ontario | Resid., munici.; busi., individ. with licensed collectors | ..... | ..... | ..... | 6 & 2 | 6 & 2 | Alley | Satisfactory |
| Petaluma | Individual, unlicensed | Tenant | ..... | ..... | 2 | 2 | Back door | Satisfactory |
| Richmond | Private; pay city $50 yr. for 5 yrs. | Tenant | 4.20 to 6.00 | Residence | 1 | 1 | Back door | Satisfactory |
| Sacramento | Municipal | Tenant | 6.00 | Residence | 1 | 1 | ..... | ..... |
| San Bernardino | Private; licensed collectors | ..... | Nothing | ..... | 2 | 1 | Back door or curb | Satisfactory |
| San Gabriel | Individual; licensed collectors | ..... | ..... | ..... | .. | .. | ..... | No |
| Santa Ana | Municipal | City | 7,000.00 | ..... | 2 | 2 | Curb | Yes |
| Santa Barbara | Individual; licensed collectors | ..... | ..... | ..... | .. | .. | Back door | No; collectors too independent |
| So. Pasadena | Municipal | ..... | ..... | ..... | 2 | 2 | Back door | Yes |
| Stockton | Individual | Tenant | 9.00 | Residence | .. | .. | ..... | Coll. under no control |
| Upland | Individual | Tenant | 12.00 | ..... | 2 | 2 | ..... | Collections irregular |
| **Colorado:** | | | | | | | | |
| Denver | Individual; licensed collectors | Tenant | ..... | ..... | 3 to 6 | 2 to 6 | Alley | Yes |
| Fort Collins | Contract | ..... | Nothing | ..... | 6 | 6 | Back door | Yes |
| Greeley | Individual; unlicensed | ..... | ..... | ..... | 3 | 3 | Back door | Yes |
| Salida | Individual; licensed collectors | ..... | ..... | ..... | .. | .. | ..... | ..... |
| **Connecticut:** | | | | | | | | |
| Bridgeport | Municipal | City | 3.41 | Ton | 1 | 1 | Back door | Total cost, $47,197 |
| Bristol | Municipal | City | 5,986.00 | ..... | 2 | 1 | ..... | ..... |
| Hartford | Municipal and licensed farmers | City | 3.39 | Cu. Yd. | 6 & 2 | 6 & 2 | Back door | Yes; some coll. pd. $300 a year |
| Middletown | Municipal | City | 14,000.00 | ..... | 2 | 2 | Curb | Yes |

# GARBAGE COLLECTION—Continued

| City | By What Method | Cost of Collection: Paid By | Cost of Collection: Per Year Amount | Cost of Collection: Per | Number of Collections Per Week In: Summer | Number of Collections Per Week In: Winter | Receptacles Collected From | Satisfactory? Remarks |
|---|---|---|---|---|---|---|---|---|
| **Connecticut (Contd)** | | | | | | | | |
| New Britain | Contract | City | 8,000.00 | ..... | 2 | 1 | Back door | Collections often irreg. |
| New Haven | Municipal and contract | City | 40,000.00 | ..... | 2 | 2 | Back door | Yes |
| New London | Municipal | City | 8,000.00 | ..... | 2, 3 or 6 | 2 | Back door | Fairly so |
| So. Manchester | Individual | Tenant | ..... | ..... | .. | .. | ..... | Yes |
| Stratford | Individual | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Willimantic | Contract | City | 2,500.00 | ..... | 4 | 2 | Curb | Yes |
| **Dist. of Columbia:** | | | | | | | | |
| Washington | Municipal | ..... | ..... | ..... | 6 | 3 | Alley | Yes |
| **Florida:** | | | | | | | | |
| Clearwater | Municipal | City | 7,200.00 | ..... | .. | .. | ..... | Yes |
| Fort Myers | Municipal | ..... | 4,200.00 | ..... | 2 | 2 | ..... | ..... |
| Gainesville | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Jacksonville | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Sanford | Municipal | ..... | ..... | ..... | 3 | 3 | Alley | Yes |
| **Georgia:** | | | | | | | | |
| Albany | Municipal and unlicensed | City | 15,000.00 | ..... | 6 | 6 | Rear | Yes |
| Griffin | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| La Grange | Municipal | ..... | ..... | ..... | 6 | 6 | Curb | No |
| Rome | Municipal* | ..... | ..... | ..... | 7 | 7 | Curb | Yes |
| **Idaho:** | | | | | | | | |
| Boise City | 2 contractors pay city $406 | ..... | ..... | ..... | 6 & 3 | 6 & 2 | ..... | ..... |
| Caldwell | Individual unlicensed | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Pocatello | Contract | City | 6,552.00 | ..... | 1 | 1 | Alley | Yes |
| **Illinois:** | | | | | | | | |
| Blue Island | Individual, unlicensed | Tenant | ..... | ..... | 2 | 2 | Curb and alley | Yes |
| Canton | Individual, unlicensed | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Champaign | Private | Tenant | 18.00 | ..... | 2 | 2 | ..... | ..... |
| Chicago | Municipal; hotels, individual, licensed | Tenant | ..... | ..... | 3 | 3 | Curb and back door | Yes |
| Chicago Heights | Municipal | City | 4,000.00† | ..... | .. | .. | ..... | ..... |
| East Moline | Contract | City | 5,000.00† | ..... | .. | .. | ..... | Yes |
| Evanston | Municipal | City | 1.05 | Cu. Yd. | 2 or 3 | 2 or 3 | ..... | Yes |
| Galesburg | Municipal | City | 14,000.00 | ..... | 2 | 1 | Back door | Yes |
| Glencoe | Municipal | Tenant | 14.00 to 54.00 | Residence | 3 | 3 | ..... | Returns about pay cost |
| Kewanee | Municipal | City | 1,576.00 | ..... | .. | .. | ..... | ..... |
| Marion | Private, licensed | Tenant | ..... | ..... | Irregular | .. | ..... | No |
| Murphysboro | Municipal | City | 3,000.00 | ..... | 6 | 6 | ..... | Yes |
| Oak Park | Municipal | ..... | ..... | ..... | 2 | 2 | Alley | Yes |
| Quincy | Contract | City | 12,400.00 | ..... | Irregular | .. | ..... | No |
| **Indiana:** | | | | | | | | |
| Anderson | Municipal and individual, unlicensed | ..... | ..... | ..... | 2 | 1 | Back door | No |
| Bedford | Contract | City | 1,100.00 | ..... | 2 | 2 | Back door | Yes |
| Brazil | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | Yes |
| Columbus | Municipal | ..... | ..... | ..... | 3 | 2 | Back door | Yes |
| Elwood | Municipal | Hotels, etc. | .07 | Collection | .. | .. | Alley or back door | Cost city $4,511 in 1921 |
| Fort Wayne | Contract | City | 41,472.00§ | ..... | 6 & 2 | 6 & 1 | ..... | ..... |
| Lafayette | Municipal | City | 7,762.00§ | ..... | 2 | 1 | ..... | ..... |
| Lebanon | Contract | City | 1,800.00 | ..... | 2 | 1 | Back door | Yes |
| Mishawaka | Municipal | ..... | ..... | ..... | 2 | 1 | Alley | Yes |
| Peru | Municipal and individual, unlicensed | ..... | ..... | ..... | 2 | 1 | Alley | Yes |
| Portland | Contract | City | 500.00 | ..... | .. | .. | ..... | ..... |
| Richmond | Municipal and individual, unlicensed | ..... | ..... | ..... | .. | 1 | Curb | Yes |
| Shelbyville | Contract | City | 15,000.00 | ..... | 2 | 1 | Back door | Yes |
| South Bend | Municipal | ..... | ..... | ..... | 2 | 1 | Alley | Yes |
| Terre Haute | Contract | ..... | ..... | ..... | .. | .. | ..... | Collections too infreq. |
| Valparaiso | Municipal | City | 2,000.00 | ..... | 4 | 2 | ..... | Yes |
| Wabash | Municipal | City | 1,600.00 | ..... | 1 | 1 | Curb and alley | Yes; some object to carrying to curb |
| West Lafayette | Contract | ..... | 720.00 | ..... | .. | .. | ..... | ..... |
| **Iowa:** | | | | | | | | |
| Cedar Rapids | Municipal | ..... | 14,783.00 | ..... | 6 | 3 | ..... | ..... |
| Charles City | Contract | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Creston | Individual | Tenant | 0 to 12.00 | Residence | .. | .. | ..... | Yes |
| Davenport | Municipal | City | 25,000.00 | ..... | .. | .. | ..... | ..... |



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | City | 12,000.00 | ..... | .. | .. | ..... | No |
| | | | | | | | | ..... |
| | | | | | | | | Yes |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dubuque | Contract | City | 12,000.00 | ..... | .. | .. | ..... | No |
| Keokuk | Individual | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Marshalltown | Private, and individual unlicensed | Tenant | 15.00 | Residence | 2 | 1 | Back door | No |
| Mason City | Municipal | City | 4,200.00 | ..... | 2 | 2 | Back door | Yes |
| Muscatine | Contract, 6 months only | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Red Oak | Individual, licensed | Tenant | ..... | ..... | 6 | 3 | Back door | Yes |
| **Kansas:** | | | | | | | | |
| El Dorado | Private | Tenant | 12.00 | Residence | 2 | 1 | ..... | Not entirely |
| Independence | Private | Tenant | 12.00 | Residence | 2 | 2 | ..... | Yes |
| Salina | Individual, licensed | Tenant | 18.00 | Residence | 6 | 2 | Alleys | Yes |
| **Kentucky:** | | | | | | | | |
| Ashland | Individual | ..... | ..... | ..... | .. | .. | ..... | No |
| Fort Thomas | Municipal | ..... | ..... | ..... | 6 | 6 | Curb | Yes |
| Madisonville | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | Collect. too infrequent |
| Paducah | Individual, unlicensed | ..... | ..... | ..... | .. | .. | ..... | No |
| **Louisiana:** | | | | | | | | |
| New Orleans | Municipal* | City | 3.00 to 4.00 | Ton | 6 | 6 | ..... | ..... |
| **Maine:** | | | | | | | | |
| Augusta | Individual | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Oldtown | Individual, unlicensed | ..... | ..... | ..... | .. | .. | ..... | Yes |
| **Maryland:** | | | | | | | | |
| Hagerstown | Contract | City | 2,240.00 | ..... | 3 | 2 | Curb | Yes |
| **Massachusetts:** | | | | | | | | |
| Adams | Municipal | ..... | ..... | ..... | 6 | .. | Back door | Yes |
| Athol | Individual, unlicensed | ..... | ..... | ..... | 2 | 1 | Back door | No |
| Beverly | Contract | City | 4,200.00 | ..... | .. | .. | ..... | Yes |
| Brockton | Municipal | City | 37,530.00 | ..... | 6 & 1 | 6 & 1 | ..... | Twice a week in summer desirable |
| Cambridge | Municipal | City | 80,000.00 | ..... | 6 & 3 | 6 & 2 | ..... | ..... |
| Concord | Private | ..... | Nothing | ..... | 3 | 1 | Back door | Fair |
| Dracut | Individual, unlicensed | ..... | ..... | ..... | 6 | 2 | Back door | Yes |
| Fall River | Contract | City | 79,000.00 | ..... | .. | .. | ..... | Yes |
| Fitchburg | Contract | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Greenfield | Contract | City | 3,000.00 | ..... | .. | .. | ..... | ..... |
| Haverhill | Contract | City | 13,500.00 | ..... | 1 | 1 | Curb or back door | Fairly |
| Holyoke | Contract | City | 8,200.00 | ..... | 3 | 2 | Back door | Yes |
| Hudson | Private | ..... | ..... | ..... | 4 | 1 | Back door | No |
| Ludlow | Contract | City | 5,500.00 | ..... | 3 | 2 | Back door | Yes |
| Lynn | Municipal | City | ..... | ..... | .. | .. | ..... | ..... |
| Malden | Municipal | ..... | ..... | ..... | 2 | 1 | Back yard | Yes |
| Medford | Municipal | City | 15,000.00 | ..... | 2 | 1 | Back door | Yes |
| Middleboro | Private | ..... | Nothing | ..... | 1 | 1 | ..... | ..... |
| New Bedford | Municipal | ..... | ..... | ..... | .. | .. | ..... | Fairly |
| Newburyport | Individual, unlicensed | ..... | ..... | ..... | 4 | 2 | Back door | Yes |
| Newton | Contract | City | 31,300.00 | ..... | 3 | 2 | Back door | Yes |
| North Adams | Contract | City | 3,150.00 | ..... | .. | .. | ..... | Fairly; collections sometimes slighted |
| Orange | Contract | City | 300.00 | ..... | 1 | 1 | ..... | Yes |
| Peabody | Municipal | ..... | ..... | ..... | .. | .. | ..... | Last year by farmers |
| Rockland | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back yard | ..... |
| Waltham | Municipal | City | 15,500.00 | ..... | .. | .. | ..... | Until recently contract. very unsatisfactory |
| Watertown | Contract | City | 8,000.00 | ..... | 2 | 2 | Back door | Yes |
| Winchester | Municipal | ..... | ..... | ..... | 3 | 2 | Back door | Yes |
| Worcester | Municipal and individual | City | 0.355 | Capita | .. | .. | ..... | Will stop individual collections |
| **Michigan:** | | | | | | | | |
| Alma | Contract | City | 2,200.00 | ..... | 6 | 2 | Back door | Yes |
| Ann Arbor | Contract | City | 16,000.00 | ..... | 3 | 2 | Back door | Yes |
| Detroit | Municipal | City | 5.59 | Ton | .. | .. | ..... | ..... |
| Flint | Municipal | City | 75,952.00 | ..... | 2 | 1 | Back door | Yes |
| Highland Park | Municipal | ..... | ..... | ..... | 2 | 2 | Alley | Yes |
| Holland | Private | Tenant | .07 | Can | 1 | 1 | Back door | Fair |
| Ishpeming | Municipal | ..... | ..... | ..... | 6 | 3 | Back door | Yes |
| Jackson | Private | Tenant | 4.80 | Residence | 3 | 2 | Back door | Yes |
| Kalamazoo | Private | Tenant | 12.00 | Residence | 2 | 2 | Back door | Yes |
| Lansing | Municipal | City | 40,000.00 | ..... | 2 | 2 | Back door | Yes |
| Ludington | Municipal | ..... | ..... | ..... | 2 | None | Curb | Yes |
| Monroe | Municipal and unlicensed | ..... | ..... | ..... | 2 | 1 | Curb | No |
| Muskegon | Municipal and unlicensed | ..... | ..... | ..... | 2 | 2 | Curb | Yes |
| Niles | Individual, licensed | Tenant | 13.00 | Residence | .. | .. | Door | No |
| Owosso | Private | Tenant | 12.00 | Residence | 3 | 3 | ..... | Yes |
| Pontiac | Contract | City | 12,500.00‡ | ..... | 6 & 2 | 6 & 2 | Back door | Fair |
| Sturgis | Contract | City | 1,600.00 | ..... | 2 | 1 | Back door | Yes |

# GARBAGE COLLECTION—Continued

| City | By What Method | Cost of Collection Per Year: Paid By | Amount | Per | Number of Collections Per Week In: Summer | Winter | Receptacles Collected From | Satisfactory? Remarks |
|---|---|---|---|---|---|---|---|---|
| **Minnesota:** | | | | | | | | |
| Austin | Private | ..... | ..... | ..... | 2 | 2 | Back door | Yes |
| Brainerd | Individual | Tenant | 14.00 | Residence | .. | .. | ..... | ..... |
| Ely | Municipal | City | 2,808.00 | ..... | 6 & 3 | 6 & 3 | ..... | Very |
| Fairmont | Individual | Tenant | 18.00† | Residence | .. | .. | ..... | ..... |
| Minneapolis | Municipal | Tenant | 2.60 | Residence | .. | .. | ..... | ..... |
| Rochester | Municipal | City | 3,500.00 | ..... | 3 | 1 | Back door | Not entirely |
| St. Paul | Municipal | ..... | ..... | ..... | 2 | 1 | Back door | Equipment antiquated |
| **Mississippi:** | | | | | | | | |
| Natchez | Municipal | City | 4,000.00 | ..... | .. | .. | ..... | ..... |
| Vicksburg | Municipal | ..... | ..... | ..... | .. | .. | Curb | Yes |
| **Missouri:** | | | | | | | | |
| Cape Girardeau | Individual, licensed and unlicensed | Tenant | ..... | ..... | .. | .. | Back door | Yes |
| Columbia | Individual, licensed | Tenant | ..... | ..... | .. | .. | Back door | No |
| Joplin | Private | ..... | Nothing | ..... | .. | .. | ..... | ..... |
| Sedalia | Individual, unlicensed | Tenant | ..... | ..... | 3 | 1 | Back door | No, should be municipal |
| **Montana:** | | | | | | | | |
| Havre | Private | Tenant | 1.35 | Residence | .. | .. | ..... | ..... |
| Kalispell | Municipal | ..... | ..... | ..... | 1.3 | 1 | Curb | Yes |
| **Nebraska:** | | | | | | | | |
| Fremont | Private | Tenant | 9.00 | Residence | 1 | 1 | ..... | Yes |
| Hastings | Private** | Tenants | 24.00 | Residence | 3 | 1 | Back door | Yes |
| Lincoln | Private | Tenants | 3.60* | ..... | .. | .. | ..... | ..... |
| Omaha | Contract | City | 79,000.00 | ..... | .. | .. | ..... | ..... |
| **New Hampshire:** | | | | | | | | |
| Franklin | Individual, unlicensed | ..... | ..... | ..... | 1 | 1 | Curb | Yes |
| Nashua | Contract and individual, licensed | City | 600.00 | ..... | 2 | 1 | Back door | No—no garbage ordinance |
| **New Jersey:** | | | | | | | | |
| Asbury Park | Contract | City | 29,000.00 | ..... | 6 | 6 | Back door | Yes |
| Atlantic City | Contract | City | 139,900.00 | ..... | 6 | 3 | Back door | Yes |
| Bergenfield | Municipal | City | 1,800.00† | ..... | .. | .. | ..... | ..... |
| Freehold | Contract | City | 3,150.00 | ..... | .. | .. | ..... | ..... |
| Hackensack | Municipal | City | 36,000.00 | ..... | 2 | 2 | Cellar or back door | Yes |
| Irvington | Municipal | City | 0.50†† | Capita | 6 & 3 | 6 & 3 | ..... | ..... |
| Montclair | Municipal | City | 30,000.00 | ..... | 3 | 2 | Back door | Yes |
| Newark | Municipal | ..... | ..... | ..... | 3 | 2 | Back door | Yes |
| New Brunswick | Municipal, some by farmers | City | 8,242.00 | ..... | 2 | 1 | ..... | ..... |
| Paterson | Municipal | City | 0.64 | Cu. Yd. | .. | .. | ..... | Yes |
| Phillipsburg | Contract and individual, unlicensed | City | 12,000.00 | ..... | 2 | 2 | Curb | Fairly so |
| Rahway | Municipal | City | 6,800.00 | ..... | 1 | 1 | ..... | ..... |
| Roselle Park | Municipal | ..... | ..... | ..... | 2 | 1 | Curb | Yes |
| Spring Lake | Contract | City | ..... | ..... | .. | .. | ..... | ..... |
| Summit | Contract | City | 29,400.00 | ..... | 3 | 3 | Cellar | Fairly so |
| Westfield | Private | Tenant | 18.00 | ..... | 2 | 2 | Back door | Yes |
| **New York:** | | | | | | | | |
| Albany | Business dist., contract | City | 4,700.00 | ..... | .. | .. | ..... | ..... |
| | Rest of city, individual, licensed | ..... | Nothing | ..... | .. | .. | ..... | ..... |
| Amsterdam | Contract | City | 28,000.00 | ..... | 2 | 2 | Back door | Yes |
| Auburn | Contract | City | 24,000.00 | ..... | 2 | 1 | Back door | Yes |
| Buffalo | Municipal | City | 2.15 | Cu. Yd. | 2 | 1 | Back door | Yes |
| Carthage | Individual | Tenant | 6.00 | Residence | .. | .. | ..... | No; three-fourths of householders do not have it removed |
| Cortland | Contract | City | 4,650.00 | ..... | 3 | 2 | Back door | Yes |
| Glens Falls | Individual | ..... | Nothing | ..... | .. | .. | ..... | No; collections irregular and uncertain |
| Gloversville | Contract | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Hempstead | Municipal | ..... | ..... | ..... | 2 | 2 | Curb | Yes |
| Herkimer | Contract | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Howell | Private | Tenant | 10.20 | Residence | 1 | 1 | ..... | ..... |
| Hudson | Contract | City | 2,200.00 | ..... | .. | .. | ..... | Yes |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Johnson City | Individual, licensed | ..... | ..... | ..... | 3 | 2 | Back door | ..... |
| Kingston | Municipal | ..... | ..... | ..... | .. | .. | Curb | Yes |
| Little Falls | Contract | City | 3,000.00 | ..... | 2 | 2 | Back door | ..... |
| Mineola | Contract | City | 2,500.00* | ..... | .. | .. | ..... | ..... |
| New York (Manhattan, Brooklyn & Bronx Boros.) | Municipal; commercial garbage by licensed collectors | City | 1.65 | Ton | 6 | 6 | House line | Yes |
| Niagara Falls | Municipal | City | 135,580.00* | ..... | 6 & 2 | 6 & 2 | ..... | ..... |
| Oneida | Individual | Tenant | 39.00 | Residence | .. | .. | ..... | Yes |
| Ossining | Municipal | City | 12,500.00 | ..... | .. | .. | Back door | No; collection from curb preferred |
| Oswego | Individual | Tenant | 5.20 | Residence | 1 | 1 | ..... | No; uncertain, unsanitary, expensive |
| Poughkeepsie | Contract | City | 30,000.00†† | ..... | .. | .. | ..... | ..... |
| Rockville Center | Contract | City | 2,000.00 | ..... | 3 | 2 | Back door | Yes |
| Saratoga | Individual, licensed | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Schenectady | Municipal | City | 172,000.00†† | ..... | .. | .. | Back door and cellar | ..... |
| Syracuse | Municipal | City | 245,000.00† | ..... | .. | .. | ..... | ..... |
| Tarrytown | Contract | City | 7,250.00† | ..... | 2 | 2 | 100 ft. from curb | Yes |
| Utica | Municipal | ..... | ..... | ..... | 2 | 2 | Back door | Yes |
| Watervliet | Contract | City | 6,600.00 | ..... | 3 | 2 | Curb | Yes |
| **North Carolina:** | | | | | | | | |
| Durham | Municipal | ..... | ..... | ..... | 3 | 2 | Back door | Yes |
| Elizabeth | Individual, licensed | ..... | ..... | ..... | .. | .. | Curb | No |
| Fayetteville | Individual, unlicensed, and municipal | ..... | ..... | ..... | 6 | 6 | Back door and curb | Yes |
| Goldsboro | Municipal | City | 1.90 | Ton | 2 | 2 | Curb | ..... |
| Greensboro | Municipal | City | 7,000.00 | ..... | 3 | 3 | Back door and curb | Yes |
| Henderson | Municipal | ..... | ..... | ..... | 3 | 2 | Curb | ..... |
| Wilmington | Municipal | ..... | ..... | ..... | 3 | 3 | Back door | ..... |
| **North Dakota:** | | | | | | | | |
| Bismarck | Contract | City | 2,000.00 | ..... | .. | .. | ..... | ..... |
| Fargo | Individual | Tenant | 12.00 | Residence | 1 | 1 | ..... | ..... |
| Jamestown | Individual, unlicensed | Tenant | 8.00 | Residence | 6 | 6 | Back door | Fairly so |
| Mandan | Municipal | City | 425.00 | ..... | .. | .. | ..... | ..... |
| Valley City | Municipal May to Nov.; individual Nov. to May | City | 1,500.00 | ..... | .. | .. | ..... | ..... |
| Washburn | Individual | ..... | ..... | ..... | .. | .. | ..... | ..... |
| **Ohio:** | | | | | | | | |
| Akron | Municipal and individual, unlicensed | City | 130,000.00 | ..... | 2 | 1 | Back door | Back door coll. too exp. |
| Alliance | Private | Tenant | 0.15 | 10-gal. Can | .. | .. | ..... | Yes |
| Ashland | Municipal and individual, unlicensed | City | 2,400.00 | ..... | 3 | 2 | Door | Yes |
| Ashtabula | Private | Tenant | 0.10 | Bushel | 1 | 1 | Back door | Partially |
| Bellefontaine | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | Yes |
| Bucyrus | Municipal and individual, unlicensed | City | 2,000.00† | ..... | 2 | 1 | Curb | Yes |
| Canton | Municipal | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Chillicothe | Municipal | City | 7,000.00 | ..... | 3 | 2 | Curb | Yes |
| Cincinnati | Contract | City | 202,500.00 | ..... | 2 | 2 | Back door and curb | Yes |
| Columbus | Municipal | City | 0.35 | Capita | .. | .. | ..... | Yes |
| Dayton | Municipal | ..... | ..... | ..... | 1 | 1 | Back door and curb | Yes |
| Delaware | Individual, unlicensed | Tenant | .10 to .15 | Can | .. | .. | Back door | Yes |
| Elyria | Contract | City | 8,280.00 | ..... | .. | .. | ..... | Yes |
| Fostoria | Municipal | Tenant | .25 to 2.00 | Collection | .. | .. | ..... | Yes |
| Fremont | Municipal | City | 2,700.00 | ..... | 6 | 2 | Back | Yes |
| Galion | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | No |
| Newark | Individual, licensed | ..... | ..... | ..... | 2 | 1 | Back door | Yes |
| Portsmouth | Municipal | ..... | ..... | ..... | 2 | 2 | Back door | Yes |
| Urbana | Private | Tenant | 0.25 | Collection | 3 | 1 | Back door | Yes |
| Van Wert | Individual | Tenant | ..... | ..... | 6 | 6 | ..... | ..... |
| Wilmington | Individual | ..... | ..... | ..... | .. | .. | Back door | ..... |
| Wooster | Private | Tenant | 6.00 | Residence | .. | .. | ..... | Yes |
| Youngstown | Contract | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Janesville | Municipal | City | 5,300.00§§ | ..... | .. | .. | ..... | Fairly so |
| **Oklahoma:** | | | | | | | | |
| Ada | Private | Tenant | 4.00 | Residence | 2 | 1 | Alley | Fair; alleys dirty |
| Blackwell | Individual, licensed | ..... | ..... | ..... | 2 | 1 | Alley | Yes |
| Enid | Private | Tenant | 3.00 | Residence | 2 | 1 | Back door and curb | Partly |
| McAlester | Private | Tenant | ..... | ..... | .. | .. | ..... | Fairly so |
| Oklahoma City | Municipal; commercial by contract | Tenant | 6.00 to 12.00 | Residence | .. | .. | ..... | ..... |

# GARBAGE COLLECTION—Continued

| City | By What Method | Cost of Collection: Paid By | Cost of Collection: Per Year Amount | Cost of Collection: Per | Number of Collections Per Week In: Summer | Number of Collections Per Week In: Winter | Receptacles Collected From | Satisfactory? Remarks |
|---|---|---|---|---|---|---|---|---|
| **Oregon:** | | | | | | | | |
| Astoria | Private | Tenant | 18.00 | Residence | .. | .. | ..... | Yes |
| Klamath Falls | Private | Tenant | 0.25 up | Collection | .. | .. | ..... | No |
| La Grande | Contract and individual, unlicensed | Tenant | 0.50 | Collection | 2 | 1 | Back door | No |
| Pendleton | Individual, licensed | ..... | ..... | ..... | 6 | 6 | Back door and curb | ..... |
| **Pennsylvania:** | | | | | | | | |
| Altoona | Municipal | City | 13,867.00§§ | ..... | 2 | 1 | ..... | Yes |
| Beaver Falls | Municipal | ..... | ..... | ..... | 3 | 1 | Back door | Yes |
| Berwick | Individual | Tenant | 0.06* | Residence | .. | .. | Curb; $3 more if at door | ..... |
| Bethlehem | Individual | Tenant | 7.80 to 8.20 | Residence | .. | .. | ..... | ..... |
| Bloomsburg | Private and individ., licensed & not | ..... | ..... | ..... | .. | .. | Back door | Yes |
| Braddock | Municipal | ..... | ..... | ..... | .. | .. | ..... | Yes |
| Carlisle | Contract | City | 2,000.00 | ..... | 2 | 2 | Back door and curb | Yes |
| Clairton | Municipal | ..... | ..... | ..... | .. | .. | ..... | ..... |
| Coatesville | Contract and individual, unlicensed | City | 6,364.00 | ..... | 3 | 2 | Back door | Yes |
| Dormont | Contract | City | 10,000.00 | ..... | 1 | 1 | Back door | No; municipal better |
| DuBois | Contract and private | City, Tenant | 1,500.00 & .04 | Total; resid. | 1 | 1 | Curb | No; people won't pay |
| Duquesne | Individual | Tenant | 10.20 | Residence | .. | .. | ..... | No |
| Easton | Municipal | ..... | ..... | ..... | 2 | 1 | Curb | Yes |
| Ellwood | Municipal | Tenant | 6.00 | First floor | .. | .. | Back door | Not self-supporting |
| Erie | Municipal | City | 3.11 | Ton | .. | .. | ..... | ..... |
| Franklin | Individual | Tenant | 5.00 | Residence | .. | .. | ..... | ..... |
| Freeland | Individual, licensed and unlicensed | ..... | ..... | ..... | 6 | 6 | Back door | Yes |
| Greenville | Private | Tenant | 9.00 | Residence | 3 | 2 | Back | Yes |
| Kittanning | Contract and individ., unlicensed | City | 250.00 | ..... | 1 | 1 | Back door and curb | Yes |
| Lebanon | Individual, unlicensed | ..... | ..... | ..... | 1 | 1 | Back | Licensing desirable |
| Lewistown | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | No |
| Meadville | Contract | City | 25,000.00 | ..... | 2 | 1 | Back door | Very |
| New Brighton | Individual, unlicensed | ..... | ..... | ..... | 1 | 2 | Back door | No |
| North Braddock | Municipal | ..... | ..... | ..... | 2 | 2 | Rear yard | Yes |
| Parkesburg | Municipal | City | 770.00* | ..... | 1 | 1 | ..... | Fairly so |
| Pittston | Contract | City | 12,000.00 | ..... | 6 | 1 | Back door or curb | Yes |
| Pottsville | Individual | ..... | ..... | ..... | .. | .. | ..... | No |
| Rankin | Municipal | ..... | 0.85§§ | Capita | 3 | 3 | Back door | Yes |
| Summit Hill | Contract | City | 2,000.00 | ..... | .. | .. | Yards | Yes |
| W. Pittston | Private and individ., unlicensed | ..... | ..... | ..... | .. | .. | Back | Yes |
| Wilkinsburg | Contract | City | 24,000.00 | ..... | .. | .. | ..... | ..... |
| **Rhode Island:** | | | | | | | | |
| Newport | Contract | City | 19,250.00 | ..... | .. | .. | ..... | ..... |
| Providence | Contract | City | 100,000.00 | ..... | .. | .. | ..... | ..... |
| **South Carolina:** | | | | | | | | |
| Charleston | Municipal | City | 72,460.00 | ..... | .. | .. | ..... | ..... |
| Chester | Municipal | City | 10.40 per day | ..... | .. | .. | ..... | ..... |
| Spartanburg | Private, licensed and unlicensed | Tenant | ..... | ..... | 6 | 6 | Back door and curb | Yes |
| **South Dakota:** | | | | | | | | |
| Winner | Individual | Tenant | ..... | ..... | .. | .. | Cans | ..... |
| **Tennessee:** | | | | | | | | |
| Cleveland | Individual, unlicensed | Tenant | ..... | ..... | .. | .. | ..... | Not ideal |
| Johnson City | Individual, unlicensed | Tenant | ..... | ..... | .. | .. | ..... | No |
| Memphis | Municipal | City | 100,068.90 | ..... | 2 | 1 | Back door | Yes |
| Morristown | Individual, unlicensed | Tenant | ..... | ..... | 6 | 4 | Curb | No; not thorough |
| **Texas:** | | | | | | | | |
| Amarillo | Individual | Tenant | ..... | ..... | .. | .. | ..... | No — city will collect garbage after complet. of incinerator |
| Beaumont | Municipal | City | $2,900 per mo. incl. inciner | | 3 | 3 | Curb | Yes |
| Dallas | Municipal | ..... | ..... | ..... | 2 | 2 | Back door | Yes |
| Denton | Individual | Tenant | 6.00 to 12.00 | Family | .. | .. | ..... | ..... |
| Eagle Pass | Individual, unlicensed | ..... | ..... | ..... | 6 | 6 | Curb and alley | Yes and no — not to householder as yard is left dirty |
| Galveston | Municipal | City | 57,880.11 yr. | City | .. | .. | ..... | Yes |
| McKinney | Individual | Tenant | ..... | ..... | .. | .. | ..... | No change contemplated |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mineral Wells | Private | Tenant | No record | ..... | .. | .. | ..... | No—probable disease germs |
| Navasota | Individual, unlicensed | Tenant | ? | ? | ? | ? | Back door and curb | No—no system—city intends taking over collection |
| **Utah:** | | | | | | | | |
| Brigham | Individual, unlicensed | Tenant | ..... | ..... | Not regular | | Back door | No—no organized meth. |
| Logan City | Municipal (city limits); individual outside | City-Tenant | $5.00 per day | City | 6 | 6 | Boxes | ..... |
| Ogden | Contractor | City | Ap. $11,000 yr. | City | .. | .. | ..... | Very |
| **Vermont:** | | | | | | | | |
| Barre | Individual, unlicensed | None | ..... | ..... | .. | .. | ..... | ..... |
| Bennington | Individual, unlicensed | ..... | ..... | ..... | .. | .. | Back door | No—tenants hire own carts |
| Burlington | Municipal | City | ..... | ..... | 3 | 2 | Back door | No—collector objects going upstairs to apt. on higher floors |
| Rutland | Individual, unlicensed | ..... | ..... | ..... | .. | .. | No | ..... |
| **Virginia:** | | | | | | | | |
| Bristol | Individual, unlicensed | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Danville | Municipal | City | 25,000.00 yr. | City | 6 & 2 | 6 & 2 | Back door | No |
| Fredericksburg | Individual, unlicensed | Tenant | ..... | ..... | Irregular | | Back door | No—contemplate municipal contract |
| Lynchburg | Municipal | City | ..... | ..... | 2 | 2 | Curb | Yes |
| Newport News | Municipal | City | ..... | ..... | 3½ | 3½ | Curb and back door | Yes |
| Norfolk | Municipal | City | ..... | ..... | 6 & 3 | 6 & 3 | ..... | ..... |
| Petersburg | Municipal | City | ..... | ..... | 3 | 3 | Curb | Yes |
| Portsmouth | Municipal | City | ..... | ..... | .. | .. | ..... | Fairly—summer no—odors bad |
| Richmond | Municipal (few individual) | City (few Ten.) | ..... | ..... | 3 | 3 | ..... | ..... |
| Roanoke | Individual, unlicensed | ..... | ..... | ..... | 2 | 1 | Alley | Yes |
| **Washington:** | | | | | | | | |
| Aberdeen | Contractor | City | Contr. parts city, part receipts | | .. | .. | ..... | ..... |
| Chehalis | Private | Tenant | 18.00-2.50 yr. Fixed by ordinance | Tenant | .. | .. | ..... | Fairly |
| Seattle | Municipal and contract | City & Contr. | 534,100.00 | ..... | .. | .. | ..... | ..... |
| Spokane | Municipal | Tenant | ..... | ..... | .. | .. | ..... | Agitation for free col. |
| Walla Walla | Contractor | City | 1,200.00 | ..... | 1 | 1 | Either | Yes |
| **West Virginia:** | | | | | | | | |
| Bluefield | Individual | Tenant | ..... | ..... | .. | .. | ..... | No—unsystematic |
| Clarksburg | Individual, unlicensed | Tenant | $6 per tenant | ..... | 1 | 1 | Back door | Yes |
| Huntington | Contractor | City | 22,900.00 | ..... | 1 & 2 | 1 &2 | Back door | Yes |
| Parkersburg | Contractor | City | 7,400.00 | ..... | .. | .. | ..... | Fairly—insufficient equipment |
| **Wisconsin:** | | | | | | | | |
| Appleton | Individual | Tenant | ..... | ..... | .. | .. | ..... | ..... |
| Ashland | Contractor | City | 1,000.00 | ..... | 2 | .. | Back door | Yes |
| Baraboo | Individual | Tenant | $10 | Family | .. | .. | ..... | ..... |
| Beaver Dam | Individual, unlicensed | Tenant | $6 | Family | 3 | 2 | Back door | No |
| Fond du Lac | Municipal | Tenant | $3 per can | Family | 2 | 1 | ..... | ..... |
| Green Bay | Municipal | City | No fig. yet | City | .. | .. | ..... | Yes |
| Janesville | Contractor | City | 7,000.00 | City | 6-3-2 | 1 | Rear | ..... |
| Kenosha | Municipal | City | $1 per yr. | Per capita | .. | .. | ..... | Yes |
| Lake Geneva | Municipal | Tenant | $6-$12 per yr. | Per family | Irregular | | ..... | No—unsanitary, fire danger, etc. |
| Menasha | Individual, unlicensed | Tenant | ..... | ..... | .. | .. | Back door | Yes |
| Milwaukee | Municipal | City | ..... | ..... | .. | .. | ..... | ..... |
| Racine | Municipal | City | $5.22 per yr. | Per ton | 2 | 2 | Back door | Yes |
| Sheboyan | Municipal | City | ..... | ..... | 2 | 2 | Back door | Yes |
| Shorewood | Contract | Tenant | $6 per yr. | Per family | 2 & 1 | none | ..... | ..... |
| Wisconsin Rapids | Municipal | City | $0.72½ per yr. | Per family | 2 | 2 | Back door and curb | Yes |
| **Wyoming:** | | | | | | | | |
| Cheyenne | Municipal | City | ..... | ..... | .. | .. | Back door and curb | No—separate coll. of garbage and ashes (now placed in same wagon) |
| Sheridan | Individual, unlicensed and licensed | Tenant | ..... | ..... | .. | .. | ..... | No—price charged exorbitant |

*Combined refuse. †Includes rubbish and ashes. §Includes cans, bottles, etc.
‡ Includes two annual collections of ashes and rubbish. ** City receives one-half of all collector gets over a guaranteed minimum of $150 a month.
†† Includes ashes.
§§Includes disposal.

# CONCRETE PAVEMENTS LAID IN 1922

| City. | Concrete Reinforced: Area | Concrete Reinforced: Cost | Concrete Not Reinforced: Area | Concrete Not Reinforced: Cost |
|---|---|---|---|---|
| **Alabama:** | Sq. Yds. | | Sq. Yds. | |
| Birmingham | ..... | ..... | 11,553 | $22,534.00 |
| **California:** | | | | |
| Santa Ana | 35,346 | $119,300[e] | ..... | ..... |
| Santa Barbara | ..... | ..... | 16,967 | .27 |
| Vallejo | ..... | ..... | 700 | 1.80[a] |
| Visalia | ..... | ..... | 1,088 | 3,272.00[i] |
| Whittier | ..... | ..... | 136,243 | 2.00[a] |
| **Colorado:** | | | | |
| Fort Collins | 50,192 | $128,521.00[a] | ..... | ..... |
| Pueblo | ..... | ..... | 16,328 | 29,451.00 |
| **Connecticut:** | | | | |
| Bridgeport | ..... | ..... | 30,000 | 75,000.00[d] |
| New London | 1,156 | ..... | 5,170 | ..... |
| New Haven | 7,000 | ..... | 71,265 | $167,400.00[i] |
| Wallingford | ..... | ..... | 7,000 | ..... |
| **Delaware:** | | | | |
| Wilmington | ..... | ..... | 823 | ..... |
| **District of Columbia:** | | | | |
| Washington | ..... | ..... | 25,000 | 1.87 |
| **Georgia:** | | | | |
| Americus | 5,589 | 1.64 | ..... | ..... |
| La Grange | ..... | ..... | 40 mi. | 2.63 |
| Macon | ..... | ..... | 3,050 | 1.60 |
| **Illinois:** | | | | |
| Benton | 17,700 | 89,000.00[e] | ..... | ..... |
| Carterville | ..... | ..... | 39,313 | 3.08[a] |
| Centralia | 58,855 | ..... | ..... | ..... |
| Champaign | 46,000 | 178,000.00[r] | ..... | ..... |
| Chicago | ..... | ..... | 455,190 | ..... |
| Chicago Heights | 10,000 | 23,400.00 | 5,000 | 11,100.00 |
| DeKalb | 3,000 | 10,000.00 | ..... | ..... |
| East Moline | 34,375 | 119,367.00[i] | ..... | ..... |
| East St. Louis | 43,300 | 168,700.00[g] | ..... | ..... |
| Edwardsville | ..... | ..... | 1,610 | 5,000.00[g] |
| Glencoe | 2,000 | 10,000.00 | ..... | ..... |
| Granite City | 42,000 | 2.83 | ..... | ..... |
| Highland Park | 20,000 | 70,000.00 | ..... | ..... |
| La Grange | 14,000 | 60,000.00[i] | ..... | ..... |
| Mattoon | 5,000 | 2.50[a] | ..... | ..... |
| Marion | 850 | 2.98[a] | ..... | ..... |
| Moline | 55,570 | 1.98 | ..... | ..... |
| Monmouth | 3,892 | 2.50 | ..... | ..... |
| Normal | 11,160 | 38,570.00[i] | ..... | ..... |
| Oak Park | ..... | ..... | 52,345 | 170,336.00[e] |
| Pana | 3,764 | 2.85[a] | ..... | ..... |
| Quincy | ..... | ..... | 478 | 1,463.00[d] |
| Riverside | 27,800 | 109,175.00 | ..... | ..... |
| Robinson | 15,000 | ..... | ..... | ..... |
| Rockford | 3.01 mi. | 160,787.00 | ..... | ..... |
| Waukegan | 14,557 | 55,444.00[i] | ..... | ..... |
| Winnetka | 1,700 | 9,000.00 | ..... | ..... |
| **Indiana:** | | | | |
| Anderson | ..... | ..... | 13,571 | 33,700.00[g] |
| Boonville | 9,000 | 2.25[i] | ..... | ..... |
| Elwood | ..... | ..... | 26,160 | 52,000.00[g] |
| Fort Wayne | 1,132 | 433,716.00[i] | ..... | ..... |
| Frankfort | 833½ | 3,017.00[g] | ..... | ..... |

# CONCRETE PAVEMENTS—Continued

| City. | Concrete Reinforced: Area | Concrete Reinforced: Cost | Concrete Not Reinforced: Area | Concrete Not Reinforced: Cost |
|---|---|---|---|---|
| **Mississippi:** | Sq. Yds. | | Sq. Yds. | |
| Hattiesburg | 5,000 | 13,000.00[d] | ..... | ..... |
| **Missouri:** | | | | |
| Boonville | ..... | ..... | 12,000 | 1.50 |
| Brookfield | 7,000 | 2.66 | ..... | ..... |
| Cape Girardeau | 1,730[m] | 2,650.00 | 8,575 | 17,195.00[g] |
| Carthage | ..... | ..... | 86,346 | 2.60[d] |
| Hannibal | 2,660 | 7,500.00[g] | ..... | ..... |
| Jefferson City | ..... | ..... | 6,600 | 2.20 |
| Kansas City | ..... | ..... | 9.0 mi. | 351,847.00[a] |
| Maplewood | 20,842 | 76,600.00[g] | ..... | ..... |
| Poplar Bluff | 40,000 | 2.62 | 30,000 | 2.50 |
| St. Louis | 9,297 | 42,937.00[g] | ..... | ..... |
| Sedalia | ..... | ..... | 44,516 | 101,291.00[d] |
| Springfield | 3,000 | 2.20 | 15,000 | 2.05 |
| **Montana:** | | | | |
| Billings | ..... | ..... | 1,702 | 2.24[a] |
| Glendive | 32,520 | 118,337.00 | ..... | ..... |
| Great Falls | 12,063 | 40,700.00 | 1,556 | 4,080.00[p] |
| Lewiston | 1,390 | 4,022.00[a] | ..... | ..... |
| Livingston | 12,100 | 34,712.00[e] | ..... | ..... |
| **Nebraska:** | | | | |
| Chadron | ..... | ..... | 4,000 | 2.64 |
| Fremont | 22,415 | 2.08[i] | ..... | ..... |
| Lincoln | ..... | ..... | 3,348.2 | 2.38[d] |
| Omaha | ..... | ..... | 8,490 | 20,123.00[d] |
| **New Hampshire:** | | | | |
| Berlin | 857.8 | 3.00 | ..... | ..... |
| Nashua | ..... | ..... | 11,281 | 2.54[n] |
| **New Jersey:** | | | | |
| Bridgeton | ..... | ..... | 40,000 | 1.80[a] |
| Camden | ..... | ..... | 0.11 mi. | 3.20 |
| Cape May | 23,777 | 2.19[d] | ..... | ..... |
| Edgewater | 21,685 | 108,425.00 | ..... | ..... |
| Freehold | 10,000 | 2.87[a] | ..... | ..... |
| Irvington | 150,000 | ..... | ..... | ..... |
| Newton | 11,200 | 32,704.00 | ..... | ..... |
| Phillipsburg | 5,533 | 16,792.00 | ..... | ..... |
| Ridgefield Park | 15,600 | 2.80[g] | ..... | ..... |
| Trenton | 8,000 | ..... | ..... | ..... |
| Wallington | 9,606 | ..... | ..... | ..... |
| **New Mexico:** | | | | |
| Santa Fe | ..... | ..... | 45,000 | ..... |
| **New York:** | | | | |
| Amsterdam | 24,000 | 62,000.00[d] | ..... | ..... |
| Auburn | 20,632 | 43,755.00[i] | ..... | ..... |
| Carthage | 2,000 | 2.50 | ..... | ..... |
| Cohoes | 1,900 | 3.28[g] | ..... | ..... |
| Corning | 23,849 | 102,289.00[g] | ..... | ..... |
| Elmira | 14,075 | 3.60[d] | ..... | ..... |
| Endicott | ..... | ..... | 4,000 | 3.50[d] |
| Gloversville | 19,650 | 55,589.00[k] | ..... | ..... |
| Gouveneur | ..... | ..... | 1,200 sq. ft | 1.50[d] |
| Herkimer | 5,500 | 30,000.00[p] | ..... | ..... |
| Johnstown | 17,500 | $2.67[a] | ..... | ..... |
| Lackawanna | 1,200 | 4,200.00[e] | ..... | ..... |
| Little Falls | 15,202 | 5.15[n] | ..... | ..... |
| Lockport | 3 mi. | 2.80[a] | ..... | ..... |
| Lynbrook | 55,000 | 2.55[d] | ..... | ..... |

| | | | | |
|---|---|---|---|---|
| Gary | 10,496 | 46,303.00[b] | 1,086 | 3,585.00[b] |
| Kendallville | 23,000 | 2.36[d] | ..... | ..... |
| Portland | 11,000 | 28,702.00[l] | ..... | ..... |
| Richmond | 28,905 | 2.22[d] | 6,133 | 2.02[d] |
| South Bend | ..... | ..... | 11,739 | 32,262.00[p] |
| Terre Haute | ..... | ..... | 2,567 | 6,550.00[d] |
| Winchester | 1,400 | 2.70 | ..... | ..... |
| **Iowa:** | | | | |
| Albion | 10,000 | 38,000.00 | ..... | ..... |
| Cedar Rapids | ..... | ..... | 10,213 | 32,334.00[l] |
| Clinton | 19,000 | 2.64 | ..... | ..... |
| Davenport | ..... | ..... | 19,823[l] | 38,977.00[g] |
| Decorah | 18,000 | 55,000.00[k] | ..... | ..... |
| Keokuk | ..... | ..... | 5,023 | 2.20[d] |
| Muscatine | ..... | ..... | 34,729.9 | 99,831.00 |
| Ottumwa | 14,680 | 2.93 | ..... | ..... |
| Sioux City | 29,000 | 90,000.00 | 42,124 | 96,400.00 |
| **Kansas:** | | | | |
| Chanute | ..... | ..... | 8,238 | 1.98[g] |
| Columbus | ..... | ..... | 9,000 | ..... |
| Ft. Scott | ..... | ..... | 10,000 | 2.45 |
| Junction City | ..... | ..... | 5,015 | 2.63 |
| Kansas City | ..... | ..... | 91,615.30 | 169,959.00[p] |
| Leavenworth | 15,000 | 2.15 | 5,000 | 2.00 |
| Parsons | ..... | ..... | 800[l] | 2.00 |
| Topeka | ..... | ..... | 16,474 | 1.90[a] |
| Wichita | 17,099 | 58,245.00[k] | 63,198 | 153,639.00[k] |
| **Kentucky:** | | | | |
| Corbin | 5,000 | 25,000.00[l] | ..... | ..... |
| Lexington | 5,700 | 15,800.00[e] | ..... | ..... |
| Ludlow | 2,444 | 2.25 | ..... | ..... |
| Paducah | 700 | 1,163.00 | ..... | ..... |
| **Maine:** | | | | |
| Bangor | 10,367 | 2.58[d] | ..... | ..... |
| Portland | ..... | ..... | 4,500 | ..... |
| **Massachusetts:** | | | | |
| Brockton | 5,670 | 3.50[d] | ..... | ..... |
| Greenfield | 3,000 | ..... | ..... | ..... |
| Haverhill | 2,310 | $7,375.00 | ..... | ..... |
| Lowell | 8,032 | ..... | ..... | ..... |
| North Adams | 11,413 | 1.73[c] | ..... | ..... |
| | | 2.15[a] | | |
| Pittsfield | 10,278 | 2.70[d] | ..... | ..... |
| Worcester | 640.9 | 3.50[d] | ..... | ..... |
| **Michigan:** | | | | |
| Ann Arbor | ..... | ..... | 811 | 2.73[a] |
| Bay City | ..... | ..... | 1,066 | $4,780.00 |
| Detroit | ..... | ..... | 263,000 | 612,032.00[l] |
| Cadillac | ..... | ..... | 9,850 | ..... |
| Grand Rapids | 5 mi. | 267,000.00[k] | ..... | ..... |
| Dowagiac | ..... | ..... | 1,423 | ..... |
| Mt. Clemens | ..... | ..... | 5,000 | 2.12[a] |
| Muskegon Heights | ..... | ..... | 1,614 6" | 1.98[a] |
| | | | 20,157 8" | 1.98[a] |
| Pontiac | 7,040 | 2.10 | ..... | ..... |
| Port Huron | 48,737 | 160,436.00[d] | ..... | ..... |
| **Minnesota:** | | | | |
| Brainerd | 26,763 | 72,534.00[k] | ..... | ..... |
| Duluth | 102,000 | 2.48[a] | ..... | ..... |
| Fairmont | 9,927 | 23,000.00[a] | ..... | ..... |
| Little Falls | 2 mi. | ..... | ..... | ..... |
| Mankato | 1,143.6 | 2,514.00 | 20,907 | 36,598.00 |
| Minneapolis | ..... | ..... | 8,763 | 31,684.00[d] |
| Rochester | ..... | ..... | 6,000 | 2.20[l] |
| So. St. Paul | 37,600 | 129,400.00[f] | ..... | ..... |
| Willmar | 70,000 | 200,000.00 | ..... | ..... |
| Massena | 12,706 | 37,834.00[g] | ..... | ..... |
| Newburgh | 3,000 ft. | ..... | ..... | ..... |
| Niagara Falls | ..... | ..... | 10,878 | 55,931.00[l] |
| Ogdensburg | 7,800 | 2.78[a] | ..... | ..... |
| Oneonta | 5,000 | 3.12 | ..... | ..... |
| Port Chester | 3,400 | ..... | ..... | ..... |
| Rochester | 990 | 3.06 | ..... | ..... |
| Schenectady | 10,896 | 50,275.00[g] | ..... | ..... |
| Syracuse | ..... | ..... | 7,430 | $34,850.00 |
| Waverly | 474 | 1,040.00[k] | ..... | ..... |
| **North Carolina:** | | | | |
| Ashville | ..... | ..... | 1,857 | 2.33 |
| Durham | 3,130 | 5.90[q] | ..... | ..... |
| Greensboro | 36,000 | 2.40[a] | 3,900 | 2.08[a] |
| **North Dakota:** | | | | |
| Grand Forks | 38,524 | ..... | ..... | ..... |
| **Ohio:** | | | | |
| Akron | 1.56 mi. | 3.80[a] / 3.17[a] | ..... | ..... |
| Bellaire | 40,000 | 3.95[l] | 1,060 | ..... |
| Bucyrus | 1,200 | 3,400.00[l] | ..... | ..... |
| Cincinnati | 10,726 | 2.49 | ..... | ..... |
| Columbus | 25,000 | 78,000.00[l] | ..... | ..... |
| Dayton | 36,106 | 83,480.00[d] | ..... | ..... |
| Delaware | 2,400 | ..... | ..... | ..... |
| Ironton | 4,800 | 2.20 | ..... | ..... |
| Lorain | 68,600 | 114,600.00[g] | ..... | ..... |
| Newark | 475 | 1,022.00[l] | ..... | ..... |
| Ravenna | 2,000 | 3.00[a] | ..... | ..... |
| Tiffin | ..... | ..... | 28,000 | ..... |
| Wooster | 500 | 2.79[a] | ..... | ..... |
| Zanesville | ..... | ..... | 860 | 2,390.00[d] |
| **Oklahoma:** | | | | |
| Chickasha | 10,498 | 28,347.00[a] | 132,441 | 33,367.00[a] |
| Enid | ..... | ..... | 37,203 | 2.78[a] |
| Muskogee | ..... | ..... | 1,660 | 3.35[r] |
| Tulsa | ..... | ..... | 4,900 | 5.00[l] |
| **Oregon:** | | | | |
| Astoria | ..... | ..... | 28,590 | 60,030.00[a] |
| Corvallis | ..... | ..... | 3,000 | ..... |
| Eugene | ..... | ..... | 16,000 | 2.20[a] |
| Marshfield | ..... | ..... | 1,562 | 2.25[a] |
| Oregon City | 1,500 | 2.80[a] | 6,800 | 1.88[a] |
| Portland | ..... | ..... | 137,533 | 299,902.00[l] |
| Salem | ..... | ..... | 35,038 | 89,010.00 |
| **Pennsylvania:** | | | | |
| Allentown | 5,445.38 | 16,011.00[d] | ..... | ..... |
| Altoona | 59,437 | 217,225.00[g] | ..... | ..... |
| Bangor | ..... | ..... | 10,000 | 30,000.00[d] |
| Blairsville | 500 | 4.00[d] | ..... | ..... |
| Catasauqua | 21,760 | 52,817.00[d] | ..... | ..... |
| Clairton | 3,185 | 2.85[a] | ..... | ..... |
| College Hill | 7,960 | 3.40[a] | ..... | ..... |
| Franklin | ..... | ..... | 796.2 | 2.48 |
| Harrisburg | ..... | ..... | 409.82 | 1,145.00[d] |
| Huntingdon | 1,300 | 3.70[d] | ..... | ..... |
| Lebanon | 4,500 | 12,600.00[l] | ..... | ..... |
| Monongahela | 552.56 | 2,044.00[g] | ..... | ..... |
| Munhall | 4,029 | 15,975.00[f] | ..... | ..... |
| New Castle | 0.494 mi. | 29,883.00[d] | ..... | ..... |
| Northampton | 516 | 2.76[a] | ..... | ..... |
| North East | 7,200 | 3.15 | ..... | ..... |
| Oil City | 1,161 | 3.30[a] | ..... | ..... |
| Sewickley | ..... | ..... | 409 | 2.99 |
| Somerset | ..... | ..... | 5,700 | 3.10[a] |
| Tyrone | 2,000 | 3.17[d] | ..... | ..... |

## CONCRETE PAVEMENTS—Continued

| City. | Concrete Reinforced | | Concrete Not Reinforced | | Reinforced |
|---|---|---|---|---|---|
| | Area | Cost | Area | Cost | Cost |
| **Rhode Island:** | | | | | |
| Cranston | 4,131 | 1.31 | ..... | ..... | .....[b] |
| Woonsocket | ..... | ..... | 8,950 | 3.60[f] | 3.60[f] |
| **South Carolina:** | | | | | |
| Greenville | ..... | ..... | 25,183 | 57,921.00[d] | 57,921.00[d] |
| **South Dakota:** | | | | | |
| Mitchell | 8,984 | 25,701.00[d] | ..... | ..... | ..... |
| Sioux Falls | 25,000 | 57,000.00[d] | ..... | ..... | ..... |
| **Tennessee:** | | | | | |
| Cleveland | ..... | ..... | 7,250 | 27,000.00[e] | 27,000.00[e] |
| **Texas:** | | | | | |
| Bonham | ..... | ..... | 300 | ..... | ..... |
| Dallas | 772.9 | 2,764.00[f] | ..... | ..... | ..... |
| San Benito | 6,500 | 3.50[d] | ..... | ..... | ..... |
| **Utah:** | | | | | |
| Salt Lake City | ..... | ..... | 1,647.0 | | 2.10[a] |
| **Vermont:** | | | | | |
| Bennington | 11,111.1 sq.yd. | 12.00 cu.yd. | ..... | ..... | ..... |
| Rutland | 2,200 | 2.02[d] | ..... | ..... | ..... |
| **Virginia:** | | | | | |
| Danville | ..... | ..... | 620 | 1,848.00[d] | 1,848.00[d] |
| **Washington:** | | | | | |
| Aberdeen | ..... | ..... | 25,166 | 86,434.00[e] | 86,434.00[e] |
| Mt. Vernon | ..... | ..... | 16,693 | 1.90[a] | 1.90[a] |
| Olympia | ..... | ..... | 59,334.3 | 114,930.00[e] | 114,930.00[e] |
| Seattle | ..... | ..... | 441,000 | 6", 1.70<br>7", 2.00<br>8", 2.25 | 6", 1.70<br>7", 2.00<br>8", 2.25 |
| Yakima | ..... | ..... | 23,420 | 56,586.00[a] | 56,586.00[a] |
| **West Virginia:** | | | | | |
| Charleston | ..... | ..... | 10,595 | ..... | ..... |
| Clarksburg | 13,130 | 79,500.00[d] | ..... | ..... | ..... |
| Fairmont | 6,209 | 20,506.00[d] | ..... | ..... | ..... |
| **Wisconsin:** | | | | | |
| Beloit | 77,833 | 179,500.00[c] | ..... | ..... | ..... |
| Eau Claire | 3,448 | 2.68 | ..... | ..... | ..... |
| Green Bay | ..... | ..... | 2,863 | 4,438.00 | 4,438.00 |
| Janesville | 27,320 | 79,400.00[d] | ..... | ..... | ..... |
| Lake Geneva | 22,880 | 39,624.00[f] | ..... | ..... | ..... |
| Manitowoc | 25,000 | 2.64[d] | ..... | ..... | ..... |
| Menomonie | 12,600 | 2.29[a] | ..... | ..... | ..... |
| Oshkosh | 657 | 1,899.00[d] | ..... | ..... | ..... |
| Sheboygan | 54,213 | 116,685.00[d] | 3,742 | 7,441.00[d] | 7,441.00[d] |
| Stevens Point | 30,000 | 1.93[a] | ..... | ..... | ..... |
| Wausau | ..... | ..... | 10,000 | 25,000.00[d] | 25,000.00[d] |
| Wisconsin Rapids | 3,000 yd. | 2.35[a] | 17,000 yd. | 2.14[a] | 2.14[a] |
| **Wyoming:** | | | | | |
| Casper | 47,006 | 2.26[a] | ..... | ..... | ..... |

[a]—Pavement only. [b]—Includes grading, curb and sidewalks. [c]—6" thick on old concrete base. [d]—Pavement and grading. [e]—Pavement, grading, curb and storm sewers. [f]—Includes grading, curb, drainage. [g]—Includes grading and curb. [h]—Entire cost, including engineering and inspection. [i]—Alleys. [m]—4" resurfacing. [n]—Includes grading and catch basins. [p]—Includes grading and underdrains. [r]—In car tracks. [s]—6" vibrolithic. [t]—Includes integral curb. [u]—Includes grading, curb, retaining walls and sewer repairs.

## Paving Notes

Rockford, Illinois, relaid 1,854 square yards of creosoted wood block pavement at a cost of $9,628. This cost includes the tearing out of the old blocks and scraping pitch off of the plank on which the blocks rested. In laying the new blocks, a ⅛-inch fibre cushion and 1-inch sand cushion were used.

---

Portland, Maine.—A sidewalk ordinance was adopted with the idea of having the city pay one-half the cost of new sidewalks, the other half being assessed upon the abutting property. In the case of cement sidewalks the work is paid for by the property owner and he receives a rebate of 62½c. a square yard from the city. In the case of brick sidewalks the city furnishes the brick and sand and the abutting property pays the city for the labor and additional cost, including that of the curb.

---

In Camden, New Jersey, 1.67 miles of granite block pavement was relaid last year. The old block had been laid on a sand foundation and the new block was laid on an 8-inch concrete base. Some of the blocks were used as found, some were renapped, some old blocks were bought and some new blocks conforming to the modern specifications. The price paid for new modern specification blocks, including base, was $6.60. Old blocks laid on a new base cost $2.65. The modern specification blocks cost $135 per thousand, while old granite blocks were purchased at $35 per thousand. Recutting the old blocks, whether purchased or removed from the street, cost $13 per thousand.

---

In New Brunswick, New Jersey, last year, in seven contracts for sheet asphalt pavement on a 5-inch base, unit prices varied from $1.25 to $1.50 for excavation, $2.98 to $3.18 for pavement, including base, from 74c. to 95c. for 6-inch by 18-inch concrete curb. One asphalt block pavement on a 6-inch base cost $3.33 per square yard.

---

Fargo, North Dakota, last year paid for sheet asphalt pavement $2 per square yard for a 5-inch concrete base and $1.60 for a2-inch wearing surface. For brick pavement it paid $2.80 for 7-inch base and $2.85 for a 3-inch brick surface.

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In Warren, Ohio, all asphalt used for repairing asphalt streets is hauled 17 miles from a mixing plant in another city.

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Scranton, Pennsylvania, owns a 1,500-yard Cummer asphalt plant which it not only uses for repairing pavements, but also furnishes contractors with asphaltic mixtures for work done by them. In 1922 the price charged f. o. b. plant was 75c. per square yard for material for 1-inch binder and 2-inch surface.

# BITUMINOUS PAVEMENTS

## Other Than Sheet Asphalt and Asphalt Concrete

**For Sheet Asphalt and Asphalt Concrete see the February Issue.**

**For Interpretation of Letters and for Foot Notes see Page 108.**

| | | Area, Sq. Yd. | Cost |
|---|---|---|---|
| **Alabama:** | | | |
| Birmingham | W.B. | 43,213 | $110,540.00 |
| **California:** | | | |
| Monterey | A.M. | 100,000 ft. | .18 |
| Oakland | T.M. | 845,698 | 267,335.00 |
| Santa Barbara | A.M. | 300,000 | .11 |
| Santa Monica | T.M. | 37,090 | ..... |
| South Pasadena | A.M. | 11,000 | 1.00[c] |
| Visalia | W.B. | 41,054 | ..... |
| **Colorado:** | | | |
| Pueblo | W.B. | 235,807 | 542,204.00[b] |
| **Connecticut:** | | | |
| Bridgeport | T.M. | 10,000 | 9,000.00[c] |
| | A.M. | 130,000 | 116,000.00[c] |
| Greenwich | A.M. | 9,206 | $1.37-$1.44[a] |
| Middletown | A.M. | 7,165 | 9,600.00[c] |
| **Florida:** | | | |
| Key West | A.M. | 50,520 | 80,000.00[b] |
| **Idaho:** | | | |
| Boise | W.B. | 16,337 | 1.98[b] |
| **Illinois:** | | | |
| Chicago | T.M. | 35,288 | ..... |
| Danville | A.M. | 1,450 | 2.65[b] |
| Joliet | T.M. | 30,000 | 4,050.00[i] |
| Quincy | A.M. | 120,890 | 109,300.00[d] |
| Rockford | T.M. | 218 mi. | 100.73 |
| Waukegan | A.M. | 1,160 | 3,943.00[r] |
| **Indiana:** | | | |
| Frankfort | R.A. | 24,477 sq. ft. | 2,734.00[a] |
| Huntington | T.M. | 3,366 ft. | 7,699.00 |
| W. Lafayette | T.M. | 700 lin. ft. | 8.00 l. ft. |
| **Iowa:** | | | |
| Clinton | W.B. | 29,000[r] | 2.34[a] |
| Davenport | W.B. | 129,132 | 463,412.00[d] |
| | W.B. | 80,000[a] | 180,363.00[d] |
| **Kansas:** | | | |
| Kansas City | W.B. | 40,247 | 116,701.00[a] |
| | R.A. | 91,679 | 300,892.00[a] |
| Parsons | T.M. | 8,800 | 1.75 |
| **Kentucky:** | | | |
| Bowling Green | R.A. | 20,000 | 21,000.00 |
| Lexington | A.C. | 9,700 | 28,000[i] |
| | A.C. | 14,500 | 79,000.00 |
| **Maine:** | | | |
| Augusta | T.M. | 1,778 | 2.70[c] |
| Lewiston | T.M. | 1 mi. | ..... |
| **Maryland:** | | | |
| Salisbury | T.M. | 24,000 | 0.18[a] |
| **Massachusetts:** | | | |
| Brockton | A.M. | 19,130 | 1.85[c] |
| Brookline | W.B. | 7,553 | 2.94 |
| | A.M. | 15,000 | 1.25 |
| | T.M. | 15,000 | 1.25 |
| | A. | 14,301 | ..... |
| Fitchburg | A.M. | 8,800 | 2.10 |
| Haverhill | A.M. | 7,727 | 11,170.00 |
| Lexington | A.M. | 25,000 | 2.56[r] |
| | T.C. | 2,250 | 1.08[r] |
| Lowell | A.M. | 20,518 | ..... |
| New Bedford | W.B. | 84,628 | 2.09[c] |
| | T.M. | 140,038 | 1.60[c] |
| Rockland | T.M. | 5,575 | 20,390.00 |
| Somerville | T.M. | 4,117 | 7,543.00[c] |
| Waltham | A.M. | 1,494 | 2,681.00[c] |
| | A.M. | 15,808 | 30,933.00[r] |
| Webster | T.M. | 1,333 | 1.35[c] |
| Worcester | T.M. | 14,478 | 1.60[c] |
| **Michigan:** | | | |
| Benton Harbor | W. | 80,000 | 1.32[a] |
| Holland | W. | 25,100 | 79,335.00[k] |
| Ironwood | T.M. | 24,000 | 2.68[m] |
| | T.M. | 20,000 | 1.50 |
| Mt. Clemens | W. | 11,200 | 2.85[b] |
| Muskegon | T.M. | 3,200 | ..... |
| Negaunee | T.M. | 25,000 | 35,000.00[i] |
| Sault Ste Marie | W.B. | 20,000 | 2.25[a] |
| | A.M. | 6,000 | 3.25[b] |
| **Minnesota:** | | | |
| Duluth | W.B. | 57,000 | 3.60[b] |
| **Missouri:** | | | |
| Hannibal | Asb. | 8,705 | 19,500.00[a] |
| | T.M. | 15,130 | 34,500.00[b] |
| Jefferson City | A.M. | 24,000 | 1.10 |
| Joplin | A.M. | 18,343 | $3,040.00 |
| Kansas City | R.A. | 0.05 mi. | 2,975.00[b] |
| | A.M. | 2.08 mi. | 75,028.00[b] |
| St. Louis | W.B. | 76,720 | 326,296.00[d] |
| | T.M. | 11,000 | 59,363.00[d] |
| Sedalia | A.M. | 16,253[r] | 8,533.00[a] |
| **Montana:** | | | |
| Billings | W.B. | 63,378 | 2.58[b] |
| Great Falls | W.B. | 18,367 | 59,300.00[c] |
| Helena | W.B. | 23,000 | 70,000.00[c] |
| **New Hampshire:** | | | |
| Laconia | A.M. | 12,468 | 2.00[c] |
| Portsmouth | T.M. | 10,000 | 38,000.00[b] |

# BITUMINOUS PAVEMENTS

| | | Area, Sq. Yd. | Cost |
|---|---|---|---|
| **New Jersey:** | | | |
| Bergenfield | T.M. | 17,320 | 90,000.00[k] |
| East Orange | W.B. | 39,354 | $2.30-$3.50[c] |
| | Nat'l | 40,690 | $2.35-$3.30[c] |
| Edgewater | T.M. | 1,505 | 2,500.00 |
| Passaic | A.M. | 2,724 | 42,480.00[d] |
| Plainfield | T.M. | 4,450 | ..... |
| Rahway | T.M. | 500 | 0.94 |
| Rutherford | A.M. | ¾ mi. | 1.25[c] |
| South Orange | A.M. | 7,180 | 12,748.00 |
| | N. | 5,507 | 19,098.00 |
| Summit | A.M. | 3,100 | 0.98[a] |
| | T.M. | 2,100 | 0.93 |
| West Orange | W.B. | 1,100 | 3.88[a] |
| | A.M. | 10,807 | 1.90[a] |
| | T.M. | 685 | 2.25[a] |
| | Nat'l | 1,180 | 2.98[a] |
| **New Mexico:** | | | |
| Roswell | W.B. | 56,000 | 2.42 |
| **New York:** | | | |
| Amsterdam | A.M. | 10,000 | 15,000.00[c] |
| Auburn | W.B. | 47,500 | 116,200.00[k] |
| Binghampton | A.M. | 1,975 | 7,000.00[i] |
| | W.B. | 25,650 | 96,700.00[i] |
| Carthage | T.M. | 3,500 | 1.50 |
| Cohoes | W.B. | 8,681 | 3.25[r] |
| Cortland | A.M. | 5,000 | 1.20[d] |
| Elmira | W.B. | 44,270 | 4.13[c] |
| Endicott | W.B. | 400 | 3.65[c] |
| Johnson City | W.B. | 1,040 | 3,348.00[b] |
| Johnstown | A.M. | 1,300 | 2.19[b] |
| Kingston | W. | 4,000 | ..... |
| | A.M. | 11,356 | ..... |
| Lockport | W. | 14,877 | 2.10[b] |
| Niagara Falls | W.B. | 4,531 | 31,658.00[i] |
| No. Tonawanda | W.B. | 28,338 | 110,050.00 |
| Oneida | W.B. | 23,442 | 95,232[d] |
| Poughkeepsie | W.B. | 2,711 | 2.30 |
| Rochester | W.B. | 48,240 | 3.20[b] |
| | W.B. | 25,500 | 2.43[a] |
| **North Carolina:** | | | |
| Durham | W.B. | 33,400 | 2.99[b] |
| Oxford | W.B. | 35,000 | 2.47[b] |
| **North Dakota:** | | | |
| Minot | W.B. | 13,279 | 57,855.00[i] |
| **Ohio:** | | | |
| Bellevue | R.A. | 11,291 | 44,070.00[i] |
| Bucyrus | T.M. | 1,650 | 4,292.00[i] |
| Cambridge | R.A. | 7,500 | ..... |
| Chillicothe | T.M. | 8,300 | 18,000.00[c] |
| Cincinnati | T.M. | 7,641 | 2.50[c] |
| Washington | T.M. | 4,300 | 2.30 |
| **Oklahoma:** | | | |
| Shawnee | R.A. | 50,000 | 2.15[b] |
| **Oregon:** | | | |
| Corvallis | W.B. | 1,600 | ..... |
| **Pennsylvania:** | | | |
| Allentown | A. | 4,337 | $13,766.00[c] |
| Butler | T.M. | 1,938 | 1.75 |
| Chambersburg | T.M. | 12,500 | 0.75[c] |
| Clairton | W. | 12,868 | 1.75[b] |
| Connellsville | W. | 13,152 | 29,593.00[a] |
| | W. | 1,636 | 7,218.00[d] |
| Hazelton | A. | 20,826 | 74,275.00[d] |
| Lebanon | W.B. | 6,200 | 22,400.00[d] |
| Norristown | A. | 3,600 | 0.97[a] |
| | T.M. | 22,060 | 22,876.00[c] |
| Sayre | T.M. | 5,000 | 1.85 |
| Throop | B. | 8,000 | 4.76[c] |
| Waynesboro | T.C. | 1,200 | 3.00 |
| | T.M. | 3,300 | 2.00 |
| **Rhode Island:** | | | |
| Cranston | A.M. | 30,282.1 | 1.11[a] |
| | T.M. | 26,025 | 0.77 |
| Pawtucket | A.M. | 19,650 | 2.50[c] |
| | T.M. | | |
| Providence | A.M. | 24,340 | 1.88 |
| Woonsocket | A.M. | 69,000 | 1.80 |
| **South Carolina:** | | | |
| Greenville | T.C. | 3,700 | 4,210.00[c] |
| **Tennessee:** | | | |
| Cleveland | T.M. | 6,075 | 20,250.00[i] |
| Jackson | W.B. | 9,000 | 1.49[b] |
| | A.M. | 75,000 | 0.30 |
| **Texas:** | | | |
| Dallas | W.B. | 10,576.9 | 436,815.00[i] |
| | R.A. | 43,214.6 | 197,540.00[i] |
| Eastland | A.M. | 19,500 | 2.50[b] |
| Georgetown | R.A. | 20,000 | 2.05[b] |
| Mineral Wells | R.A. | 5,000[a] | ..... |
| Paris | W.B. | 4,333 | 3.45[c] |
| Mexia | R.A. | 17,500 | 3.27 |
| San Angelo | A.M. | 90,000 | 1.44 |
| **Utah:** | | | |
| Ogden | W.B. | 96,269 | 342,390.00[r] |
| **Vermont:** | | | |
| Rutland | A.M. | 4,500 | 0.90[c] |
| **Washington:** | | | |
| Puyallup | W.B. | 7,271 | 17,713.00[d] |
| Walla Walla | W.B. | 10,100 | 1.69 |

## BITUMINOUS PAVEMENTS

| | | Area | Cost |
|---|---|---|---|
| **Wisconsin:** | | | |
| Baraboo ..... | T.M. | 1,600 | ..... |
| Eau Claire ..... | A.M. | 8,727 | 1.35 |
| Oshkosh ..... | T.M. | 11,223 | 22,296.00[c] |
| **Wyoming:** | | | |
| Casper ..... | W.B. | 23,647 | 2.11[b] |
| Sheridan ..... | W.B. | 26,719 | 2.97[b] |

A.—Amiesite. A.M.—Asphalt macadam. Asb.—Abesphalt. B.—Bitoslag. N.—National. R.A.—Rock asphalt. T.C.—Tar concrete. T.M.—Tar macadam. W.—Willite. W.B.—Warrenite-Bitulithic. [a]—Surface only. [b]—Surface and base. [c]—Surface, base and grading. [d]—Surface, base, grading and curb. [e]—Surface, base, grading, sewer adjustments. [f]—Surface, base, grading, curb, drainage. [g]—Surface, curb and gutter. [h]—Surface, base, grading, curb and gutter. [i]—Entire improvement. [k]—Entire improvement, including engineering, inspection, etc. [l]—$28,000 on macadam base, $79,000 on concrete base; includes pavement, grading, curb and storm sewers. [m]—$2.68 on 6" concrete base, $1.50 on 6" macadam. [n]—Includes scarifying and rolling old macadam and adding about 2 in. of top. [r]—Resurfacing over old pavement. [s]—Surface, base, grading, catch basins and drains.

## Snow Equipment for Boston

The Mayor of Boston, Massachusetts has authorized Joseph A. Rourke, commissioner of Public Works, to investigate the possibility of purchasing from the Federal Government or elsewhere 40 or 50 tractors to be provided with snow plows for the removal of snow next winter; also two mechanical snow loaders for discharging snow into trucks at the side. The Mayor stated that snow removal work this year up to March 1 has cost $450,000 and in addition the presence of snow has caused the destruction of pavement in Massachusetts avenue and Beacon street which it will require $250,000 next spring to repair, most of the damage being done by chains on heavy truck tires travelling in deep ruts in the snow.

## Snow Removal in New York

The commissioner of the Department of Street Cleaning of New York, Alfred A. Taylor, is receiving credit for unusually effective performance of the snow removal functions of his office during the past winter. The "Woman's Municipal League," in a bulletin dated February 27th, says: "This winter when we read that the snowfall has been exceptionally heavy, we are somewhat surprised because we have never been less incommoded by the snow in our streets. The reason for this is the efficient snow removal." The bulletin then goes on to state that Commissioner Taylor is the first man, for many years at least, to rise to this position through the ranks of the department. Previous commissioners have generally been taken from outside the department, but Mr. Taylor has been connected with it for 23 years, first as a driver, then as section foreman, assistant foreman, borough superintendent, general superintendent, deputy commissioner and finally commissioner. The Woman's League attributes his unusual success in snow-removal to his long training in the department.

The conditions under which he has been keeping the streets passable this winter are indicated by his report made on February 7th to the Board of Estimate and Apportionment in asking for authorization for the issuance of $1,000,000 special revenue bonds for the removal of snow and ice. In this communication he states that up to that date the total fall of snow had been about 36 inches in 11 storms, while the average snowfall for an entire winter is about 24 inches. The snowfall for the winter has therefore been about double the average; in spite of which this civic organization states that the citizens have never been less incommoded by snow. It might also probably be said that never have the papers had less to say about the handling of the snow. Apparently Mr. Taylor has not maintained a publicity bureau, as did some of the previous commissioners.

Since the same men and, to a large extent, the same equipment is used in snow-handling as is in regular use for collection of ashes and garbage, almost every piece of equipment, both horsedrawn and motor, has been in service during the winter. The extent of this equipment was shown in the table in the December issue of Public Works, wherein the department was stated to have on hand 15,000 hand scrapers, 110 bottom-dump wagons, 2 snow-loading machines, 300 push snow plows, 129 5-ton trucks, 12 7½-ton trucks, 100 2-ton trucks and 129 tractors.

Drivers receive $5.45 per day and a request was made by Mr. Taylor that an allowance be made for about 20,000 additional days of driver service to provide for the unusual amount of snowfall. In addition to these, from 1,000 to 4,000 laborers are employed by the day in emergency work after each snowfall.

## Cost of Contractors' Bonds

Henry G. Shirley, chairman of the State Highway Commission of Virginia, has been endeavoring to obtain from the bonding companies doing business in that State a reduction of the rates charged contractors on State work, which charges are of course added to the cost of this work to the state.

The chief claim made is that the bonding companies are charging 1½% on the total cost of the contract, whereas under the state specifications the contractor is required to put up a bond of only 30% of the contract price. Mr. Shirley claims that 1½% should be charged against this 30% rather than on the total amount of the contract. The charge made really amounts to 5% on the amount of the bond. The Commission believes that the 30% is sufficient to cover any losses that may be brought about due to the failure of the contractor to comply with the contract and specifications. On February 28 the Commission stated that it expected to bring the matter to the attention of the General Assembly and it is said this may result in the State deciding to eliminate the bonding companies and carry the risks itself.

## Garbage Contract for Indianapolis

The City Sanitary Commission of Indianapolis on Feb. 28 awarded a contract for digesters for the new city garbage disposal plant to the William G. Morrison Company. The plant is to be of 200 tons capacity. The award was made

on the recommendation of E. W. McCullough, consulting engineer on the garbage plant construction. The bid for these digesters was $126,800 and Mr. McCullough estimates that the entire plant with the buildings will cost not more than $375,000.

# Landslides and Their Prevention

Pittsburgh, Pennsylvania, has had some landslides which, because of the damage they have done, have attracted quite general attention. Similar slides, however, have occurred with less disastrous results in many parts of western Pennsylvania, and, in fact, in various sections of the United States, especially those where clay occurs in synclinal hillsides with rather steep slopes. This phenomenon was discussed before the Engineers' Society of Western Pennsylvania by H. R. Thayer of Pittsburgh. Mr. Thayer's paper is given below:

Western Pennsylvania was formerly a bed of shale and silt lying at the edge of a vast inland sea occupying what is now the basin of the Mississippi. Then some convulsion of nature elevated it, and the drainage systems began to cut out channels. The resulting topography in the vicinity of Pittsburgh has been a series of ridges and valleys. The surface of the shale has disintegrated into clay, and every engineer in the district realizes the problem thereby created. Every cut in these slippery slopes brings with it its risk. They speak about "putting money in a hole," but those who have to contend with a slide do not even get this satisfaction, for the ooze soon fills up every last semblance of any excavation.

I do not know of any better example, however, of the useful application of the truths of science to everyday affairs.

**Classification of Earth Movements**—We may classify earth movements as of five different types:

The first occurs where the earth is deposited or cut into at a slope exceeding the angle of repose, usually assumed for earth at about 34 degrees. The usual and proper remedy is to flatten the slope or to build a retaining-wall if the former course is impracticable.

The second case is where a heavy load is placed upon the earth. This is really a special case of the first variety and has the same remedies.

The third case is that caused by the disintegration of the material. It gives trouble where too high an angle of repose has been assumed. This is an error likely to occur when excavating in friable rock.

The fourth case, fortunately rare in this district, is caused by earthquakes. There is no remedy; at least, none at present. One has to take what is sent him.

The fifth case, common in this vicinity, is what is called a "slide." In a hillside, apparently solid, an irregular mass breaks loose. The top cracks and heaves in an irregular manner, while a clayey mass pushes out as a toe at the bottom. The motion may be very slow, say a few inches per year to a few inches per day. The force developed is very large and construction to hold it must be correspondingly massive.

So far as the writer knows, slides occur only in a clay soil. Keep clay perfectly dry and it is a most dependable material. Under these circumstances it will remain vertical for a long time if not indefinitely; but water changes its character entirely, rendering it a most treacherous material. Its angle of repose becomes very low, possibly something like 10 degrees. As we should expect, the angle at which the clay will stand depends largely upon the moisture present therein; and if anything happens to increase its moisture content its stability is decreased, and if this goes far enough, movement begins and we have a slide. So far as the writer knows, water is the only cause of slides. If ground which has been stable for a long time starts to move, it will be because the slope has been changed or unusual amounts of water have been introduced.

**Methods of Treating Slides.**—There are four methods of treating a slide:

The first is to restrain it by means of piles or a retaining wall. Great strength is often needed to make this effective, and these methods are always expensive. The next idea is to "dig it out." This is archaic, expensive, and generally unsatisfactory. There are cases, however, where it is the only thing to be done, although often involving very large amounts of material.

The third method is to drain the affected area, thereby removing the water, which is always the cause of the trouble. This is likely to be expensive, but has proven quite satisfactory.

The last method is one of prevention. It is usually available and will be in every way the most satisfactory. The first step is a careful and thorough investigation. There should be a topographical survey with borings, also a history of the slide with rainfall records and progress chart. The amount of water flowing from the foot of the slide and its variation and nature should be carefully observed. The water may be from springs, from the surface, sewage, or water-supply. From the above data it should be easy to determine the source.

The next step—locating the definite place from which the trouble comes—will not give engineers very much trouble as these methods are too well known to need elaboration here. If it be a leaky waterpipe it is resoldered or, better still, moved to a more favorable location. Sewer-pipe we may likewise mend or move, while surface drainage may be ditched off the slope. The treatment of spring water will give the most trouble, but, since this has always been present, the chances are that it is not the cause, unless someone has been careless enough to fill directly over a spring.

To prevent a slide:

If possible, avoid digging into a clay slope carrying water in greater or less quantities. If

it must be done, drain thoroughly and keep out all the water you can. Locate water and sewer-pipes as far away as you can. Turf the slopes.

If water can be excluded, and you can be sure that external water will always be kept out, a slope of 34 degrees (1½ to 1) can be used with confidence.

## Public Engineering on Part Time

The following letter from the township engineer of Cranford, N. J., was probably suggested chiefly by the article on page 56 of our February issue, telling of an investigation of the subject being made by the American Association of Engineers:

Editor, Public Works,
New York City.

Dear Sir:

Regarding engineering of public work on part time, your articles are interesting as a subject of importance to engineers and also to community interests. I believe the underlying difficulty in devoting engineering practice exclusively to public work is the uncertainty as regards permanence of effort and the desire on the part of the public to engage efficient talent with insufficient remuneration. The public is the ruler of its own destiny and is apt to measure economy in terms of competition without regard to the fact that competition for municipal progress is a vague element ranging somewhere between prosperity and stagnation. In such a case of competition the low bidder is apt to be kept busy making both ends meet, and is driven to the necessity of seeking additional revenue from outside sources. Even when a community has managed to secure a competent engineer with sufficient salary to liberate his attention to public interests he is apt to be made the target for political attack which has the same effect in demanding a financial anchor to windward in self-defense.

We see evidences all around us of engineers of attainment who have been thrown into the discard without intelligent reason. Men who have been in harness on the particular work in question, who have had to correct mistakes, who have perfected an organization and established policies for the future, who have the imagination and vision to record future ideals and the courage to follow them, who understand the outside influences which must necessarily modify public engineering ambition and men who have been specially trained to understand the interwoven fabric of the particular work, thrown out without justification and the responsibilities turned over to one who, whatever his qualifications may be, cannot hope to grasp every phase of the situation for a long time and may then inadvertently undo much valuable work.

As long as the engineer holds his term of office between election days, so long will any competent engineer decline to undertake responsibilities which require years of effort unless he has other profitable channels for keeping alive. Until there is some substantial evidence of sincerity in consistent progress, his loyal interest can hardly be expected. If his work cannot be supported by confidence both ways, his efforts are futile. If he is underpaid his interest in the work is in the same proportion, or less.

It is not a reflection on public officials to say that most of the smaller municipalities suffer from the fact that their entire present and future is given over to officials who have to direct it during spare moments, with the result that progress is often propelled by explosive impulse rather than calm understanding or by authority instead of judgment. Various departments may operate efficiently and each perform its own function but with the obvious lack of coordinated vision which limits progress to routine necessities. Succeeding administrations come and go and rarely with full appreciation of the technical needs and functions which really hold things together. An official can hardly be expected to assume responsibilities beyond his probable term of office.

The result of this part-time service is that there is no one persistently studying the future and recommending steps to anticipate the growing needs. Bills for improvements are collected and things drift along until some appalling disaster shows that they are way behind the times and a hysterical impulse tears things up that might have been made to anticipate such inevitable conditions had there been some one on the job to look ahead.

These are the wastes of magnitude, compared to which a real salary for a permament, full-time engineer is the biggest kind of insurance. I believe progress can be made without destruction or disaster and that it will cost much less to keep ahead of the times than it will to be everlastingly trying to keep up.

Every step forward in building up a community is an essential part of the inheritance we are building for future generations. If we study the history of such developments we find a blazing trail of shortsighted blunders which, if repeated at present-day values, will become disastrously extravagant. We find expensive improvements have to be destroyed to make room for unexpected needs. We find that indifference to the future or lack of vision or initiative has passed golden opportunities to provide for the future and vital matters have later forced themselves upon them at ruinous costs. The people come and go but the fundamental process of development should go on in an unbroken plan of advancement based upon an intimate familiarity with all elements which combine to our economic growth.

The responsibility of the public is an elusive quantity, that of the elected officials is apt to be limited to the spare moments they can devote to the generalship of public work, the engineers' responsibilities embrace only such accomplishments as are made during an indefinite term of office, probably on part time, and the limited powers conferred upon him by the governing body. To whom then can the blame be assigned for past shortsighted mistakes? History repeats itself but it is now a period when repetition spells serious expenditures.

There are many problems in public work which must be controlled by the judgment of the public through their elected representatives. Financial developments must be directed by the prevailing conditions and the raising of funds follows the desire of the public who pay the bills. Improvements and new construction must follow the developments as they occur. Legal procedure will change as time goes on. New problems will come up for analysis at any time, but the existing physical properties of a community are a living reality representing the investments of a generation which must be protected against abuse, deterioration and manipulation at any hazard. An intimate knowledge of their construction, their limitations, their ills and their suitability to future extension is a most essential factor to good judgment in emergency and cannot be comprehended under a sporadic supervision nor on part-time service.

The maintenance and development of public property presents many complications mostly of an engineering character and all worthy of an engineering supervision. When the public appreciate the true value of a permanent engineering management they may feel sure of competent upkeep and consistent progress. When they realize that the comparative expense of a full-time engineering supervision lies not so much in the amount paid as in the economies secured by the prudence of management, then I feel sure competent engineers will enthusiastically welcome the lure of public achievement, at full time and for life, even at a sacrifice of financial ambition; but it must be for a term of office that renders their success possible and will insure an uninterrupted exchange of confidence and cooperation without political interference.

D. C. NEWMAN COLLINS, M.Am., Soc. C.E.

## A Record Year for Asphalt

It is stated by the Asphalt Division of the Standard Oil Company that 1922 was a record-breaking year for asphalt paving on the Pacific coast. During that year contracts were awarded in the five Pacific coast states for constructing 49,250,000 square feet of asphaltic concrete base and surface pavements. In 1921 the total was a little over 40,000,000, and in 1920 a little over 28,000,000 square feet for this type of pavement.

The gains in asphaltic concrete surfacing on various types of bases and in asphalt and oil macadam pavements are even greater. The total area of pavements laid in 1922 in which asphalt was used amounts to 108,000,019 square feet, equivalent to 1290 miles of a 16-foot highway.

## Road Construction in Illinois

The Division of Highways of Illinois has published a statement giving the amount of roadwork completed during the years 1921 and 1922, the latter of which was a record year for the State. At the peak of construction as much as 41 miles of 18-foot Portland cement concrete pavement was being constructed each week and it is believed that this rate would have been maintained if not increased but for the rail strike, coal strike and cement and coal shortages. In spite of this, 722 miles of pavement was constructed during the year, which is claimed as the world's record in mileage of pavement completed in any one year by any one State. Another record is claimed for length constructed in one day, one of the contractors having laid 1,583 feet of 18-foot concrete pavement in one day of ten hours.

The total work done during the two years comprised 1,137 miles of pavement, 343 miles of grading and 272 bridges. In addition to this, the State had under contract but not completed on January 1st, 676 miles of pavement of the bond issue system and 114 miles of State aid pavement; 103 miles of grading under the former and 5 miles of grading under the latter, and 103 bond issue bridges and 16 State aid bridges.

## The Beccari Garbage Disposal Process

An entirely new idea in garbage disposal which has been tried out in Italy is being introduced in this country by the American Beccari Corporation, with which are associated J. Waldo Smith as president, Jules Breuchaud as vice-president, James F. Sanborn as secretary, and other engineers and contractors.

The process is the invention of Dr. Guiseppe Beccari and is claimed to change garbage unmixed with other refuse matters into a practicable fertilizer. There is practically no cost of operation, but the garbage is deposited in covered masonry cells from 8 to 10 feet in each of the three dimensions. Each cell has a charging hole on top and a door in one face through which the finished product is removed; also a low tower on the roof.

The garbage is dumped through the charging hole and the liquids are drained off through the bottom, which is provided with fine holes or slots, from which it is conducted to the sewer or other conduit for removal. Air also enters through the same perforations in the bottom. Four shelves projecting about 2 inches from the wall extend in a continuous line along the four sides of each cell and about 2 feet apart vertically. Each tower contains four shelves around its circular perimeter on which are placed absorbent earth and sulphated iron, which are supposed to fix the volatile products (nitrogen and ammonia) carried upward in the air rising from the cell, which air has entered through the perforated bottom and also up vertical air ducts which are placed in each corner and are connected with the unfilled space created underneath each horizontal shelf, the purpose of these shelves being to distribute the air through the cell. The cells are ordinarily built in units of four with one tower at their common corner and serving all four cells.

When the garbage has fermented in a cell for from forty to forty-five days, the temperature meantime having risen to about 150° F., it is found that chemical and bacterial action have reduced the garbage to a dry, inoffensive mass having the nature of humus. This is removed through the doors and when a cell has been emptied it is ready for a new charge. Each cell receives about 24 cubic yards at a charge and it is estimated would therefore serve about 1,000 population of a residential community.

It is claimed that such a plant creates no dust, smoke, gases or other nuisance and can thus be placed at any point in the city where land is available and hauling can therefore be kept at a minimum, that the operation costs are very low and the deterioration as well, and that it produces a fertilizer which finds a ready market.

## Value of Cost Accounting

Cost accounting has become established as necessary for a contractor who is to profit at the business and should be introduced by and required of all public works departments, especially in cases where such works are performed by the department directly by day labor. Some cost accounting systems, however, are so complicated or unwisely planned that they do not secure a maximum of benefit and may even cost more than they are worth.

The Fabricated Production Department of the Chamber of Commerce of United States has issued twelve rules for testing the value of a cost accounting system. Although prepared for a manufacturing business, most of the rules apply to contract work also. These rules, which it recommends applying for analyzing the soundness of a cost system, are as follows:

Does your cost system give you up-to-date costs, not merely history?

Does it aid in stabilizing your wages and piecework rates?

Does it point out defects in your routing system?

Does it help you maintain a perpetual inventory?

Does it increase your production?

Does it measure your overhead?

Does it detect new overhead expense?

Does it point out leaks in expense?

Does it encourage your employees?

Does it promote intelligent competition?

Does it point to non-profit paying lines?

Does it permit you to bid safely?

# Recent Legal Decisions

### CONTRACT OF EMPLOYMENT OF ARCHITECT FOR PUBLIC WORK MUST BE MADE BY PROPER AUTHORITY

A city passed a resolution that an architect be selected to prepare a preliminary statement and estimate of probable cost of improvements to the city market, for a sum of $100, and should the council determine to proceed with the work at any time, such architect should be employed to prepare the plans and specifications and superintend the work at the standard charges. An architect was selected and prepared the preliminary statement and estimate, for which he was paid $100. Bids for the work were advertised for under a resolution of the city, but none was accepted and the work was never proceeded with. The architect subsequently sued the city for preparing plans and specifications under directions orally given him by the chairman of the market committee. The Georgia Court of Appeals, Mayor, etc., of Savannah, v. Kops, 113 S. E. 99, holds that it was error to overrule a demurrer to the petition, because it was not alleged that upon the authority of the mayor and aldermen the market committee contracted with the plaintiff for any additional plans or estimates other than the estimate for which he was paid. It was not alleged that he prepared any specifications other than those for which he was paid, prior to the resolution which directed an advertisement for bids. It was not shown by the petition that any proper resolution "to proceed with the work" was ever passed by the city. Under the court's view of the resolution authorizing the employment of an architect, it would have been necessary for the city to express by proper resolution its intention to proceed with the work, and for a contract to be duly entered into by the proper authority with the plaintiff, in accordance with the resolution.

### OPTION TO TAKE OVER WORK — ALTERATIONS CONTEMPLATED BY CONTRACT DO NOT RELEASE SURETY

The West Virginia Supreme Court of Appeals holds, State v. R. M. Hudson Paving & Construction Co. et al., 113 S. E. 251, that where a county court enters into a contract with a contractor for the permanent improvement of a public road, which provides that, in case the contractor shall make default in the due performance of the contract, the county court, in case such default shall continue for a specific period after notice, shall have full power and authority to take the work, in whole or in part, out of the contractor's hands or otherwise, it is not bound to do so, but may sue the contractor and its surety upon its bond without taking over the work. If the contract permits alterations in work or materials at the option of the county court, the surety will not be discharged by material alterations in work or materials without its express consent, where such alterations are contemplated by the terms of the contract.

A county court entered into a "blanket form" contract for all the work and materials in the construction of a public road. Six different kinds of paving materials were designated, upon which the contractor made alternate bids upon a unit basis. The paving material finally agreed upon was rocmac, but by the terms of the contract the county court reserved the right to make any changes in the work or materials it might deem proper. The contractor executed the usual bond. The county court afterwards substituted concrete of a 1-2-4 mixture for the rocmac paving, the contractor agreeing to furnish and lay it for the same price per square yard. Such a change, though made without the knowledge of the surety, was held not to release it from its liability. The damages were assessed as of the date of the breach of the contractor's contract.

### CITY BOARD OF COMMISSIONERS CANNOT DELEGATE DISCRETIONARY POWER TO MAKE CONTRACTS TO ONE COMMISSIONER

The Kentucky Court of Appeals holds, Jamieson v. City of Paducah, 241 S. W. 327, that a city council, board of commissioners, or fiscal court cannot delegate to another, not even to its individual members, the performance of official duties involving the exercise of discretion, and if it attempts to do so the action or contract of the agent is not binding on the official body. An attempt by a board of commissioners of a city to delegate to commissioner the power and authority to act for and on behalf of the city in making a contract for plans and specifications for a public building, without limit as to price, was held to be an attempt to confer upon him the exercise of a discretionary power. Had the board ratified the contract and entered a proper order, the city would have been bound, but this had not been done. The most the ordinance conferred on the commissioner was authority on behalf of the city to consult with the architect concerning plans and specifications and to submit any proposition which he might receive from the architect to the board for consideration and approval. It is also held that persons dealing with a municipal corporation are bound, at their peril, to know that the contracts made by the officials of such corporation are executed in the mode pointed out by its charter and ordinances, and if such persons fail to inform themselves as to whether the official has power to contract, they must suffer the consequences. "A city council or board of commissioners of a municipality can speak only through its records. The city can contract in no other way. It cannot be made liable on an implied contract, except where it has received goods, property or benefits, and applied the same to its own use, and the said property or benefits can be restored to the person from whom the municipality obtained the same without destroying the city property to which it is attached, and then its liability goes only to the extent of the reasonable value of such material in the place where found, after the city elects to keep it."